ANNUAL REPORT

FOREST PEST CONDITIONS IN WISCONSIN

1969

WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FORESTRY AND RECREATION
BUREAU OF FOREST MANAGEMENT

FOREST PEST SURVEY AND CONTROL

NATURAL RESOURCES BOARD

JOHN M. POTTER, *Chairman*
Wisconsin Rapids

D. K. TYLER, *Vice-Chairman*
Phillips

RICHARD A. STEARN, *Secretary*
Sturgeon Bay

HERBERT F. BEHNKE
Shawano

ROGER C. MINAHAN
Milwaukee

STANTON P. HELLAND
Wisconsin Dells

GERARD A. ROHLICH
Madison

DEPARTMENT OF NATURAL RESOURCES

L. P. VOIGT
Secretary

JOHN A. BEALE
Deputy Secretary

PREFACE

In 1969, restrictions continued to tighten on use of pesticides of all kinds. Suitable pesticides are not available for control of some of our major forest pests. Thus, it is more important than ever that we add to our knowledge of our major pests so we can take maximum advantage of various types of control when the need and opportunity arises.

This year, as almost every other, has been an "unusual one". New problems have come to our attention as a result of observations made by many individuals. Information on the new problems and many old familiar pest problems may be found in the text.

Of special interest may be one that has seriously affected saleability of Scotch pine Christmas trees in the central counties. Rapid action on the problem, a needle blight, provided an effective interim control until the problem and its impact can be studied more thoroughly.

The Pest Control Staff thanks all who contributed to the material published in this report.

Donald W. Renlund
Chief, Forest Pest Survey and Control

CONTENTS

Page

Preface
Organization Map 1
Major Forest Insects:

Coleoptera: 2
Bronze Birch Borer...Two-Lined Chestnut Borer...Elm Flea Beetle...Cottonwood Leaf Beetle...Pales Weevil...Pine Root Collar Weevil...Pine Root Weevil...Native Elm Bark Beetle...Pine Bark Beetles...June Beetles...Northern Pine Weevil...White Pine Weevil...Smaller European Elm Bark Beetle...Shot Hole Borer...Weevil

Diptera: 6
Balsam Gall Midge...Red-Pine Needle Midge

Homoptera: 7
Pine Spittlebug...Saratoga Spittlebug...Spruce Gall Aphids...Balsam Twig Aphid...Black Pine Needle Scale...Pine Bark Aphid...Pine Tortoise Scale

Hymenoptera: 10
Introduced Pine Sawfly...Red-Headed Pine Sawfly...Red Pine Sawfly...Jack Pine Sawfly...Larch Sawfly

Lepidoptera: 12
Cankerworms...Pink-Striped Oakworm...Large Aspen Tortrix...Oak Webworm...Oak Skeletonizer...Birch Skeletonizer...Spruce Budworm...Jack Pine Budworm...Pine Tussock Moth...Zimmerman Moth...Elm Spanworm...Jack-Pine Shoot Borer...Aspen Blotch Miner...Eastern Tent Caterpillar...Forest Tent Caterpillar...European Pine Shoot Moth...Spruce Needle Miner

Orthoptera: 24
Walkingstick...Post Oak Locust

Grasshoppers, Other Arthropods, Black Flies 25

Major Forest Diseases:

Wilts and Diebacks: 26
Dutch Elm Disease...Oak Wilt

Root Rots: 28
Annosus Root Rot...Tomentosus Root Rot

Stem and Branch Diseases: 29
White Pine Blister Rust

Page

Foliage Diseases: 30
Austrian Pine Needle Blight...Brown Spot Needle Blight...
Air Pollution...Balsam Fir Needle Rust...Ink Spot of Aspen...
White Pine Needle Blight

Nursery Diseases: 36
Black Walnut Root Rot...Lophodermium Needle Cast

Other: 38
Snow Damage...Drought

Appendix:

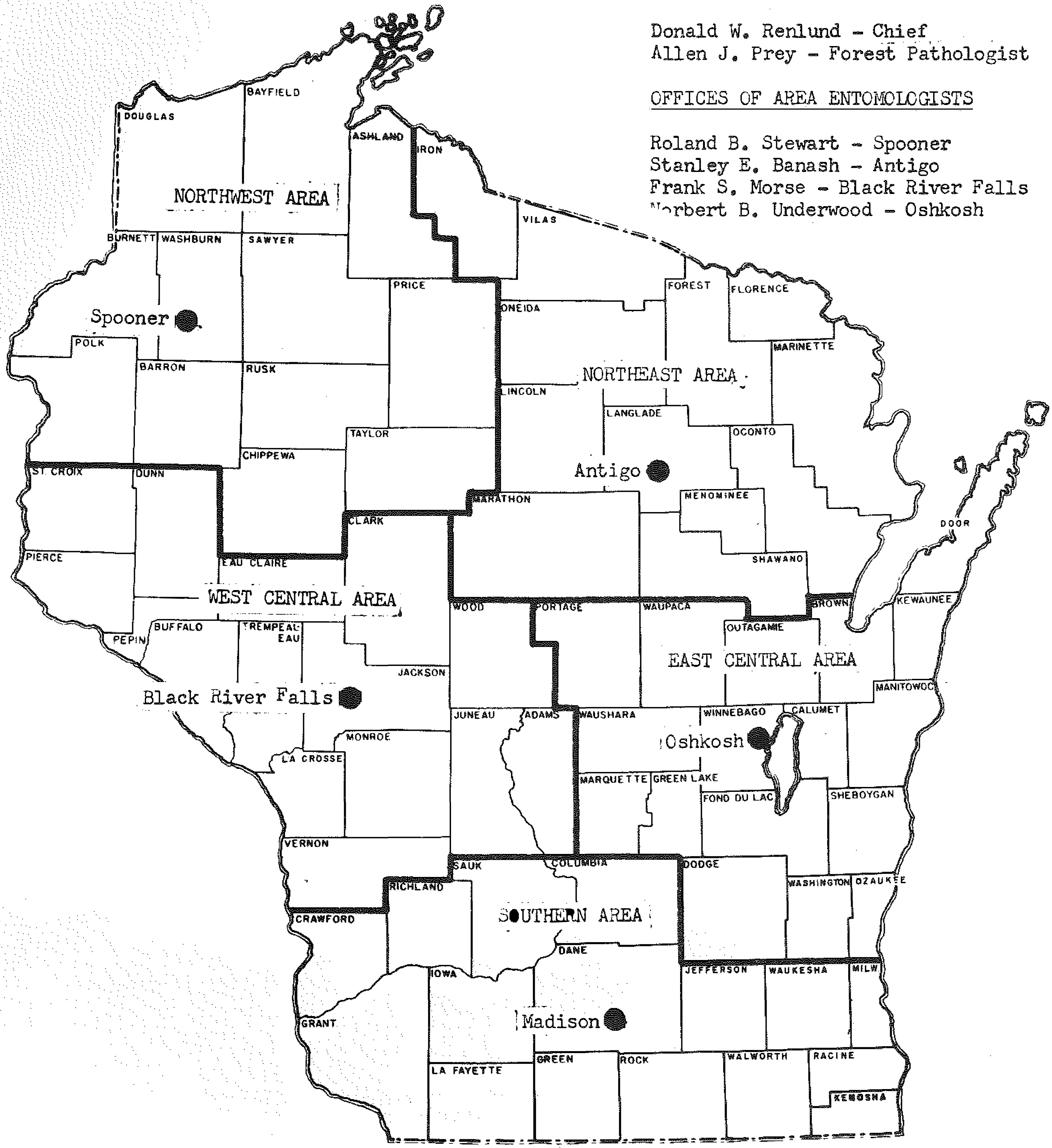
The Native Elm Bark Beetle in Northern Wisconsin, 1968-69. . . . 39
Chemical Control - Jack Pine Budworm 51
Di-Syston Application for Balsam Gall Midge Control 62

FOREST PEST SURVEY AND CONTROL
HEADQUARTERS AND SOUTHERN AREA OFFICE
Nevin Hatchery, Madison

Donald W. Renlund - Chief
Allen J. Prey - Forest Pathologist

OFFICES OF AREA ENTOMOLOGISTS

Roland B. Stewart - Spooner
Stanley E. Banash - Antigo
Frank S. Morse - Black River Falls
Norbert B. Underwood - Oshkosh


NORTHWEST AREA
NORTHEAST AREA
WEST CENTRAL AREA
EAST CENTRAL AREA
SOUTHERN AREA
Spooner
Antigo
Black River Falls
Oshkosh
Madison
DOUGLAS
BAYFIELD
ASHLAND
IRON
VILAS
BURNETT
WASHBURN
SAWYER
PRICE
FOREST
FLORENCE
ONEIDA
POLK
BARRON
RUSK
MARINETTE
LINCOLN
LANGLADE
TAYLOR
OCONTO
CHIPPEWA
ST. CROIX
DUNN
MARATHON
MENOMINEE
CLARK
DOOR
PIERCE
EAU CLAIRE
SHAWANO
WOOD
PORTAGE
WAUPACA
BROWN
KEWAUNEE
OUTAGAMIE
PEPIN
BUFFALO
TREMPEALEAU
JACKSON
MANITOWOC
JUNEAU
ADAMS
WAUSHARA
WINNEBAGO
CALUMET
MONROE
LA CROSSE
MARQUETTE
GREEN LAKE
FOND DU LAC
SHEBOYGAN
VERNON
SAUK
COLUMBIA
DODGE
WASHINGTON
OZAUKEE
RICHLAND
CRAWFORD
DANE
IOWA
JEFFERSON
WAUKESHA
MILW.
GRANT
LA FAYETTE
GREEN
ROCK
WALWORTH
RACINE
KENOSHA

MAJOR FOREST INSECTS

COLEOPTERA

Bronze Birch Borer - Agrilus anxius Gory

Infestations were found in many shade and ornamental white birch trees throughout the northwest counties. Activity by the borer, combined with effects of severe drought is expected to result in considerable tree and branch mortality which will become evident in the spring of 1970.

Two-Lined Chestnut Borer - Agrilus bilineatus (Weber)

No new oak mortality, attributable to this insect, was reported from west central or northeastern counties where borer activity had been reported in 1967 and 1968.

Elm Flea Beetle - Altica ulmi Woods Germar

Widespread defoliation of individual trees was noted in western Shawano and eastern Marathon Counties. Foliage of trees in many elm stands appeared gray in mid-August. Beetle larvae skeletonizing the leaves and adults found in bark crevices have been tentatively identified as Altica ulmi Woods.

Cottonwood Leaf Beetle - Chrysomela scripta Fabricius

Defoliation of aspen by a beetle tentatively identified as the cottonwood leaf beetle covered an area of approximately 31 square miles in Lincoln County. Defoliation was severe enough to be readily mapped from the air in T33N, R5E and T34N, R4E and R5E. Ground checks of the area on July 31 revealed beetle larvae skeletonizing the lower surface of the leaves. Pupal and adult stages were also present.

Pales Weevil - Hylobius pales (Herbst)

Less adult feeding damage (flagging) was noticed on Scots pine Christmas trees in the west central counties during 1969 than in preceding spring seasons. Adult feeding during the fall of 1968 and the spring of 1969 caused heavy loss of seedlings planted in 1968 in an Adams County plantation (Section 28, T16N, R7E) and some damage was noted in a 1969 planting in Jackson County (Section 33, T19N, R5W). Heavy harvest cuttings had been made in each of the plantations in recent years, and they had not been treated for control of root collar weevil during the last five years. Evidence of feeding by pales weevil larvae is readily found in stumps and roots of most Scots pine Christmas tree plantations during harvest years.

Phenological Note:

July 24 - Pupae found in up-rooted stumps lying on ground surface in Waushara County.

Pine Root Collar Weevil - Hylobius radicis Buchanan

The status of the insect in northwest counties remains the same -- it is a serious pest in Christmas tree plantings, especially Scots pine, but no new infestations were found or reported in forest plantings.

Few new infestations were reported in the west central counties where the insect is found in most Scots pine plantations, and many jack and red pine plantings.

Seedling Scots pine planted in areas cut the previous season were severely injured by feeding adult weevils in a Portage County plantation. Two genera were represented in weevil collections readily made during a brief period in daylight hours. Weevils in the genus Hylobius were tentatively identified by taxonomists as either H. radicis or H. congener. The other genus represented was Pissodes, and the species either P. strobi or P. approximatus. Collections were made in the following locations: Government Lots 8, 9, 10, 11, 12, Section 30, T21N, R9E; W½NW¼NE¼NW¼, Section 33, T21N, R10E. Typical weevil injury is illustrated in Figure 1.

Phenological Note:

July 24 - Pupal stage predominant in root collar zone in Waushara County. One adult and one larva in 12 specimens collected.

Pine Root Weevil - Hylobius rhizophagus Millers

Some flagging and tree mortality was observed in areas of known infestation in Polk, Burnett and Washburn Counties, but no new infestations were reported in the northwest counties for the second consecutive year.

Infestations continued to destroy jack pine plantations in several west central counties, however.

A survey of Nekoosa Edwards Paper Company jack pine and red pine seed source plots in Wood and Adams Counties indicated infestations throughout the jack pine, and flagging was evident in red pine adjacent to the jack pine in the Wood County plots. Thinning experiments in infested jack pine plantations (Jackson County, Section 6, T21N, R3W - 1964) indicate that thinning may delay stagnation from root weevil infestation but will not prevent it. Thinned plots are heavily infested now.

Native Elm Bark Beetle - Hylurgopinus rufipes (Eichhoff)

This beetle is found with the smaller European elm bark beetle over the east central counties, but is the predominant beetle. With the death and removal of trees of poor vigor, local beetle populations appear to be dropping proportionately. Rock elm appeared to be slower in its response to beetle attack.

A detailed special report about the beetle in northern Wisconsin, and particularly in Menominee County starts on page 39.

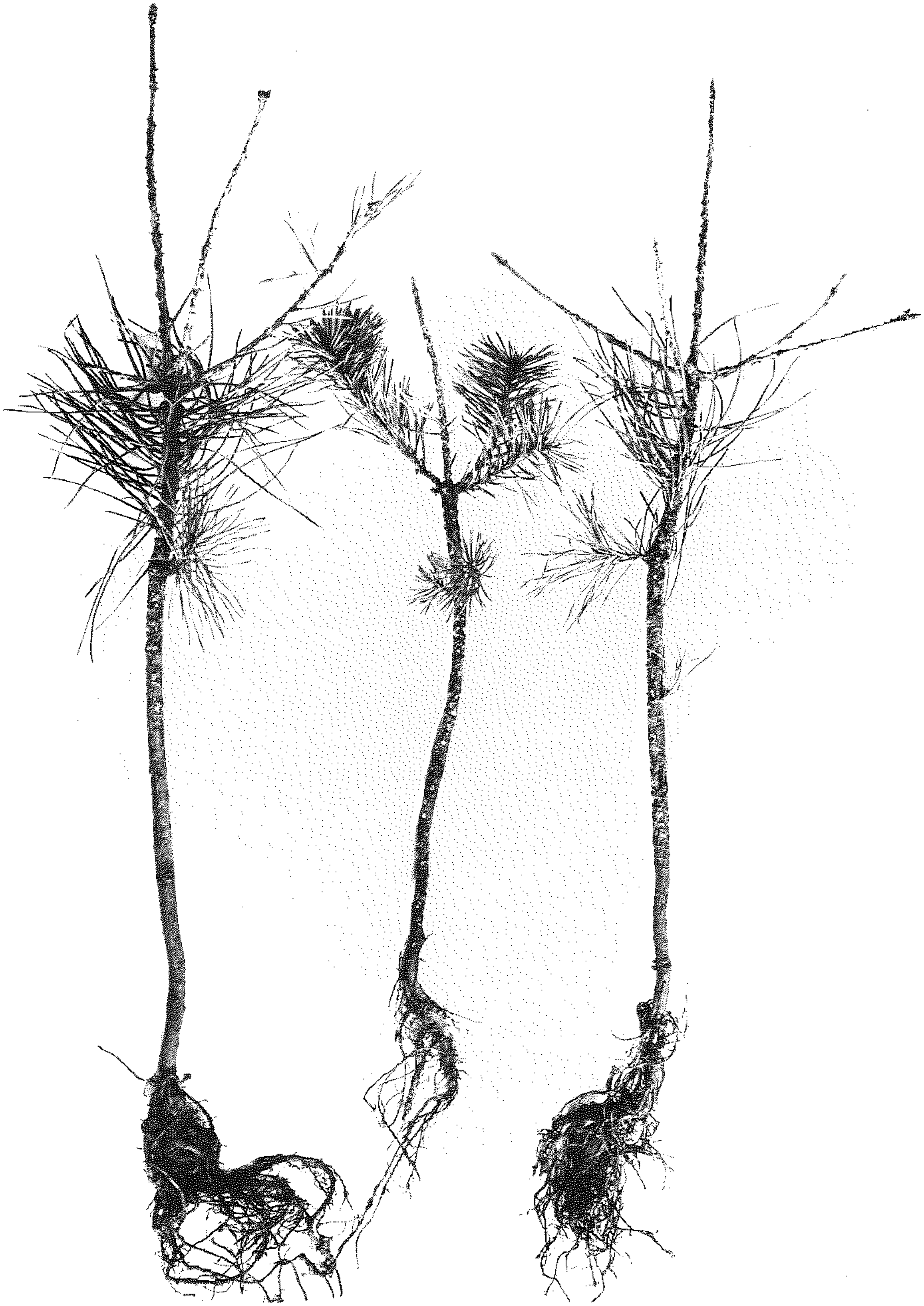


Figure 1 - Weevil-injured Scots pine from a 1969 spring planting in Portage County. An effort made to destroy stumps and other beetle-breeding debris prior to planting, apparently was inadequate. Most of the young trees were fatally damaged by Hylobius and Pissodes weevils.

Pine Bark Beetles - Ips spp.

A late summer drought contributed to successful beetle attacks and tree mortality in northwest counties. Except where other factors provided conditions conducive to more extensive mortality, usually only one or two trees were killed at a given location. A change of road grade caused flooding and erosion which killed several red pine in a twenty-year-old plantation in Washburn County (Section 18, T40N, R11W). Bark beetles multiplied in these trees and the second generation moved out into healthy trees nearby causing top-killing and tree mortality. Another plantation in Washburn County (Section 13, T42N, R12W) was thinned commercially in late winter and early spring providing slash for a bark beetle build-up. The second generation from this source also moved into surrounding trees causing scattered tree mortality.

Populations were low during early summer in the west central counties, but drought conditions during August favored an increase in late broods in jack-pine timber sale areas. Some trees were killed in residual stands but damage was negligible.

No new infestations were noted in standing timber during the season in the northeast, but a heavy infestation was found in a winter-thinned plantation (NWNE, SWNE Section 32, T37N, R18E) where tops and pulp logs were heavily infested with larvae and adult beetles on July 9.

June Beetles - Phyllophaga spp.

Very little damage to trees was reported from the northwest and adults were scarce. Moderate beetle flights were reported from the west central counties, but no seedling losses were apparent. Similarly, little June beetle activity was reported from other parts of the state.

Northern Pine Weevil - Pissodes approximatus Hopkins

Seedling Scots pine planted in the spring among stumps of the same species cut the previous year, were severely damaged in Waushara County. The weevil population was so heavy that hundreds of specimens of ordinarily nocturnal species were collected in broad daylight during a brief period. A "preventive spray" had been applied on 800 acres shortly after planting. Most of the injury to the trees occurred in September and October. Tentative determination of the weevils involved indicated that two genera were involved. Pissodes strobi or P. approximatus, and Hylobius radicis or H. congener, are the possible species involved.

(See comments under H. radicis).

White-Pine Weevil - Pissodes strobi (Peck)

Northwest - Incidence of damaged leaders indicated a definite increase in weevil populations throughout the northwest counties on all species of pines. While no individual stands were found to have a high incidence of weeviling, roadside trees and scattered trees in most stands had dead tops.

Northeast - Populations were generally light in most northeastern counties where terminals of scattered individual white pine, jack pine, red pine and Norway spruce were observed. Between 1% and 2% of the terminals were infested in a young jack pine plantation in Marinette County (Section 9, T34N, R18E).

West Central - Weevil damage increased in white pine plantations and natural stands in Clark and Jackson Counties where 10% to 20% of the terminals were infested in some plantations. In most plantations in other west central counties infestations were observed in less than 5% of the leaders.

East Central - Populations reached relatively high levels after being very low for 3 consecutive years. Many owners failed to take advantage of low populations in plantation maintenance. Dry weather appeared to have had an adverse effect on the insect.

Smaller European Elm Bark Beetle - *Scolytus multistriatus* (Marsham)

No change in distribution records.

Shot Hole Borer - *Scolytus rugulosus* (Ratzeburg)

Very abundant in elms killed in 1968 by aerial herbicide application along a power line in Vilas County (Section 28, T42N, R12E). This was the first time the insect has been collected from dead elms in the thousands of elms examined for native elm bark beetles. Date of observation: August 4, 1969.

Weevil - *Sciaphilus asperatus*

This weevil was abundant in the Antigo area (Langlade County). It was reported previously in the 1960 and 1963 Annual Reports - Forest Pest Conditions in Wisconsin.

DIPTERA

Balsam Gall Midge - *Dasyneura balsamicola* (Lintner)

A moderate infestation was reported on natural balsam in Washburn County (Sections 14, 15, T38N, R13W).

Many balsam fir plantings were heavily infested in Langlade, Lincoln and Oneida Counties. Heavily infested areas were those shaded by hardwoods much of the day and those on an east exposure.

Control efforts with methoxychlor and malathion were ineffective. Unfavorable weather conditions during May are suspected of delaying adult emergence and contributing to the poor control results achieved with chemicals.

Treatments were recommended for the period May 10 to May 14 on the basis of emergence dates the past few years. However, midge traps showed that the first adults emerged in the plantations on May 27 and emergence continued until June 1. Second treatments were not applied.

Rapid shoot elongation continued even though adult midge emergence was delayed. This combination of events nullified the possibility of control with chemicals. Expanding shoots provided ample opportunities for the late-emerging midges to oviposit on uncontaminated plant tissues. Malathion would have disappeared during the period of delay and coverage with methoxychlor would not have been complete enough to prevent infestation.

Control of the midge was attempted with a test application of Di-Syston, 15% Granular, to a Langlade County plantation, NESW Section 36, T31N, R11E. Details may be found on page 62 in the section on Chemical Control.

Phenological Notes:

May 5 - Approximately 50% of balsam fir buds have broken dormancy. This is 10 days earlier than normal. No adult midges observed in traps. Little or no frost in ground. Maple, elm, basswood beginning to leaf out (Langlade County).

June 3 - Midges present in traps. Galls, about 1/32" long, are appearing on new growth. The plantation, treated with methoxychlor on May 10. Section 36, T31N, R11E.

Red-Pine Needle Midge - *Thecodiplosis piniresinosae* Kearby

Infestations were very light in West Central red pine stands, except for the Adams County plantation reported in 1968 (Quincy Township - Section 18, T16N, R5E). High populations caused heavy defoliation again in 1969. Some tree deformity resulting from top killing is expected in the plantation following two years of severe defoliation.

A suspected infestation was reported from the Lone Rock area (Sauk County).

HOMOPTERA

Pine Spittlebug - *Aphrophora parallela* (Say)

Spittle masses were common throughout the northwest counties in 1969, but heavy infestations were less prevalent than in recent years immediately preceding. A few jack pine stands in Washburn County (T42N, R13W) and in Douglas County (T43N, R13W and T44N, R10 and 11W) had moderate to heavy infestations.

Only scattered light infestations were observed in Langlade and Shawano County Scots pine plantations where infestations had been the heaviest experienced in years during 1968. Chemical control with technical malathion at 16 fluid ounces per acre, directed at the adults in 1968, had proved very effective.

A heavy infestation in a young jack pine plantation was reported in Section 19, T32N, R18E (Marinette County), where most nymphs were in the 2nd instar on June 2.

Spittle masses were less prevalent in the central and southern counties than the year before.

Phenological Note:

May 19 - Nymphs 1/8" long on old growth of Scots pine.

Saratoga Spittlebug - Aphrophora saratogensis (Fitch)

Nymphs were numerous in some red pine plantings in Section 8, T44N, R12W (Douglas County). Heavy flagging from 1968 feeding combined with hail damage inflicted the same year and the current nymphal infestation threatened the plantation with destruction. Plans were made to treat it with chemicals. However, high adult populations did not materialize and control plans were cancelled.

No new locations of spittlebug damage were reported and no nymphal surveys were made in the West Central counties. A few adult spittlebugs were observed in red pine plantations during August but populations were low.

An infestation in SWSE Section 16, T25N, R8E (Portage County) was reported for the first time. Three locations (2 in Waupaca County, and 1 in Portage County) which had high populations for two consecutive years showed a very marked spittlebug population reduction. The owner of the Waupaca plantations followed a recommendation to remove all unthrifty trees in two pockets with the results indicated, and the peripheral trees are in excellent condition.

A large population of blackbirds, mostly redwings, were observed intensively feeding in the Portage County location during the period of spittlebug transformation from nymphs to adults. It is suspected that the activity of the birds contributed significantly to the insect population decline.

Severe infestations were reported in young red pine plantations in Marinette, Oneida and Vilas Counties. Previous year's feeding injury had caused heavy flagging and some tree mortality. Many of the plantations were privately owned and some were treated with insecticide. Malathion in No. 2 fuel oil, applied by contract aircraft at the rate of 1/2 pound of active ingredient per gallon of finished spray per acre, was used to treat 120 acres on the following descriptions:

Oneida County	SW¼NE¼ Section 27, T37N, R8E	40 acres
Vilas County	NE¼ Section 31, T40N, R7E	80 acres

An ultra-low volume application of malathion was made on 362 acres of red pine plantations on the Northern Highland State Forest with the state-owned spray plane. Technical malathion was applied undiluted to provide 10 ounces of active ingredient per acre on July 29 and 30.

Sections 4, 8, and 9, T42N, R7E	110 acres
Section 5, T42N, R7E	14 "
Sections 35 and 36, T43N, R7E	23 "
Section 16, T42N, R7E	14 "
Sections 13 and 24, T42N, R6E	30 "

Section 10, T42N, R6E	47 acres
Section 3, T42N, R5E	24 "
Section 3, T42N, R7E	12 "
Section 2, T42N, R6E	18 "
Section 29, T42N, R6E	54 "
Section 16, T42N, R6E	16 "
Total	362 acres

Back-pack mist blowers were used to treat 32 acres of red pine with malathion at the rate of one-half pound active ingredient in one gallon of #2 fuel oil mixture per acre on July 31. The following descriptions were treated:

NESW and S½SW¼ Section 7, T37N, R21E	6 acres
W½SE¼ Section 1, T37N, R21E	13 "
W½NE¼ and NESW Section 19, T35N, R19E	8 "
NESE Section 26, T36N, R18E	5 "
Total	32 acres

Pest control personnel surveyed approximately 1,200 acres of state, county, industrial and other private forests to evaluate nymphal populations in the northeast counties. Some private landowners failed to follow through with control recommendations, even though names of contractors and sources of materials and equipment were furnished. Several of these neglected plantations were severely damaged.

Phenological Notes:

May 14 - 1% of the spittlebug eggs had hatched in Oneida County.

June 23 - 80% of the nymphs in the 3d stage in Marinette County.

July 25 - 80% of spittlebugs in the adult stage in Oneida County.

Spruce Gall Aphids
Cooley Spruce Gall Aphid - *Chermes cooleyi* Gillette
Eastern Spruce Gall Aphid - *Chermes abietis* Linnaeus

Populations were epidemic in the east central counties.

Phenological Note:

July 13 - Insects started emerging from galls collected on blue spruce at Cedarburg (Ozaukee County) on July 5.

Balsam Twig Aphid - *Mindarus abietinus* Koch

Infestations were generally light to moderate in practically all balsam plantings in Langlade, Lincoln and Shawano Counties. Several Christmas tree growers applied malathion at one-half pound active ingredient in 3 gallons of water per acre and prevented damage to new shoots. The most severe infestations were in the NWNE Section 36 and NESE Section 23, T31N, R11E.

Moderate infestations were confirmed on balsam fir Christmas trees in Monroe County (Section 35, T18N, R2W) and in Jackson County (Section 5, T20N, R3W). Aphids and curled needles were found on 90% of the trees sampled and on 30% to 60% of the buds in the Monroe County location on May 19, 1969. The owner attempted chemical control on May 24 and results were fair.

Following excellent overwintering conditions, a heavy infestation continued in Section 1, T16N, R8E (Marquette County). An application of malathion early in the season produced good control.

Black Pine Needle Scale - Aspidiotus californicus Coleman

Light populations observed on scattered jack pine in Section 23, T36N, R20W in Polk County.

Pine Bark Aphid - Pineus strobi (Hartig)

Populations were considerably higher in the Hayward Nursery on white pine. An application of lindane and one of nicotine sulfate were made to reduce their numbers. Shade and ornamental trees, especially on lake shore property, were frequently reported to be harboring high populations in the northwest.

Phenological Note:

May 12 - Crawlers settled on new white pine shoots which were up to 75 mm long and needles 4-5 millimeters long (Dane County).

Pine Tortoise Scale - Toumeyella numismaticum (Petit & McDaniel)

Very few infested trees were found in jack pine and Scotch pine stands in the west central counties as infestations declined to low levels.

No serious infestations were reported in the northeast but a few widely distributed trees with high populations were observed in Marinette and Florence Counties.

No infested areas were found or reported in the northwest in 1969. The insects were found only on scattered trees or small groups of jack pine.

HYMENOPTERA

Introduced Pine Sawfly - Diprion similis (Hartig)

Spring populations were generally low in the northwest counties, but localized infestations in the fall resulted in a few reports of moderate defoliation on white pine in Burnett County around Wood Lake, and in Washburn County at Shell Lake.

Numbers of larvae higher than previously encountered in infestations in the east central counties caused little noticeable defoliation on white pine Christmas trees in SWNE Section 6, T20N, R9E (Waushara County).

Although larvae were present in many Scots and white pine stands in the west central counties, no noticeable defoliation was reported.

Visible defoliation was apparent on open-grown trees and along the edges of white pine stands along highways 45 and 49 south of Antigo (Marathon and Shawano Counties).

Red-Headed Pine Sawfly - Neodiprion lecontei (Fitch)

A few scattered colonies were found on roadside trees and on ornamental jack pine in the city of Shell Lake (Washburn County).

Colonies of larvae were found in most northeast county plantings examined in late August. Light infestations were reported in Forest and Langlade Counties, but trees were more heavily infested in Menominee, Oconto and Shawano Counties. This was the first year in several that noticeable defoliation occurred over such a wide area.

Two red pine plantations about 8 years old were treated with malathion at the rate of 1/2 pound of active ingredient in one gallon of fuel oil by a contract aerial applicator on August 18. The forester in charge reported excellent results. Sixty-five acres were treated in NW¼ Section 26, T30N, R16E, and 70 acres in parts of Sections 3 and 10, T29N, R16E.

The sawfly has been scarce in the east central counties for the past 10 years. A few colonies were observed in northern Waupaca County (T25N, R11E).

Although scattered colonies and feeding sites were frequently noted on jack pine reproduction in Jackson and Trempealeau Counties, no appreciable damage was observed.

Phenological Notes:

August 18 - Larvae were in the 5th instar in Menominee County.

September 5 - Most larvae had dropped to the duff, but a few colonies could still be found on the trees in Langlade and Florence Counties.

Red Pine Sawfly - Neodiprion nanulus nanulus Schedl

The only report of this insect was from Shell Lake (Washburn County) where two colonies were found on ornamental red pine in June.

Jack Pine Sawfly - Neodiprion pratti banksianae Rohwer

Several colonies of larvae were found in T45N, R10W in Douglas County. The sawfly was not observed elsewhere in the state.

Larch Sawfly - Pristophora erichsonii (Hartig)

Northwest - Spotty defoliation was common throughout the northwest counties. Defoliation was generally lighter than in 1968. Only an occasional tree was severely defoliated. Plots have been checked to determine the influence of the insect on the trees.

Northeast - Severe defoliation occurred in many individual tamarack stands in Langlade, Oneida and Vilas Counties, while numerous others escaped noticeable defoliation.

West Central - Light to medium defoliation occurred in many stands in Clark, Jackson and Wood Counties.

East Central - Heavy defoliation was observed on a few isolated trees in NWSE Section 12, T25N, R11E (Portage County).

LEPIDOPTERA

Cankerworms
Fall Cankerworm - Alsophila pometaria (Harris)
Spring Cankerworm - Paleacrita vernata (Peck)

About 50 acres of oak and maple were defoliated in Sections 33 and 34, T32N, R26E on Chambers Island (Door County).

Pink-Striped Oakworm - Anisota virginiensis (Drury)

The same area of scrub oak in Douglas County (parts of Sections 15, 16, 21, 22, T43N, R12W) that was completely defoliated in 1968, was completely defoliated again. Some trees were dead, or nearly so from the 1968 defoliation. The added injury is expected to cause more tree mortality. The overall area covered by the infestation expanded very slightly north and south to encompass between 400 and 500 acres of oak type dotted with summer cabins.

Phenological Notes: (Douglas County)

June 11 - 20	Moths active and ovipositing on oak leaves. Eggs laid on underside of leaves.
June 30	Eggs were starting to hatch and young larvae were feeding on foliage.
July 14	Larvae in 1st, 2nd and 3d instars.
July 28	Larvae range from 2nd to 5th instars.
August 12	Larval feeding completed and all pupated. Several dead larvae hanging on trees.

Large Aspen Tortrix - Archips conflictana (Walker)

Larvae were present again in many aspen stands in Ashland, Price, Rusk and Taylor Counties. Moderate to heavy defoliation occurred in northern Douglas County (T49N, R10 and 11W) and northern Bayfield County (T49N, R6W, T50N, R5W). Fifth instar larvae were noted in a three acre patch of aspen in Langlade County (Section 5, T31N, R5E) on June 23.

Oak Webworm - Archips fervidanus (Clemens)

Colonies were common in parts of Douglas County, but far less numerous than in 1968. They were scattered throughout the scrub oak type but no areas of heavy infestations were found.

Oak Skeletonizer - Buccalatrix ainsliella Murtfeldt

Evidence of the oak skeletonizer could be found with ease almost everywhere in the oak type across the length and breadth of the state. Defoliation provided a bronze cast to foliage which ultimately turned brown by August in some of the hardest-hit stands. It was particularly noticeable on the tops of hills and ridges across the central counties and along the western side of the state through Eau Claire County.

Browning and partial defoliation of oak were especially noticeable in Eau Claire, Portage, Sauk, Waupaca, Menominee, Oconto and Shawano Counties by the end of July. Cocoons literally covered the ground vegetation in the understory by mid-August in some oak stands.

Fall populations were epidemic in Clark, Eau Claire, Jackson, Juneau, LaCrosse and Monroe Counties. A report from Jackson County noted "a porch deck being slippery because of larvae dropping from nearby oak trees" as they dropped out of the trees to cocoon and pupate on almost any readily available surface. At least one Christmas tree grower expressed concern over the "pine needle scale" on his pine trees as he prepared to market them in the fall.

The last similar outbreak of the oak skeletonizer occurred in 1961. Pupal parasites were not much in evidence from a few collections made in the fall. In one batch of 40 cocoons from Sauk County, one tiny irridescent green wasp emerged.

Phenological Note:

July 17 - Larvae pupating in northeast Portage County.

Birch Skeletonizer - Buccalatrix canidensisella Chambers

Premature browning and defoliation of birch was prevalent in birch stands along the west side of the state and across the northern tiers of counties but defoliation was variable in intensity. Birch in the Black River State Forest in Jackson County and some parts of Clark County were heavily defoliated. Light to moderate infestations were noted in parts of T44N, R6W and T45N, R5W in Bayfield County.

Spruce Budworm - Choristoneura fumiferana (Clemens)

A build-up of spruce budworm populations was found in parts of Washburn and Sawyer Counties in scattered balsam stands. Defoliation was very light in T41N, R11W (Washburn County), and generally light to moderate in Sections 1, 2, 3, 20 and 21, T42N, R9W (Sawyer County) except for severe defoliation on some trees. Egg masses were difficult to find in the stands examined and it is doubtful if populations will build-up to outbreak proportions in 1970. U. S. Forest Service personnel reported the same conditions in the Chequamegon National Forest in Sawyer County.

Phenological Note:

June 23 - About 30% of the larvae had pupated.

July 29 - Eggs hatching in Chequamegon National Forest.

Jack-Pine Budworm - Choristoneura pinus (Freeman)

Northwest

Budworm populations were generally low throughout the northwest counties. Although early larval counts were quite high in one area in Burnett County (Sections 8, 9, 10, 15, 16, 17, 18, T39N, R17W), defoliation was light to moderate in these stands, and egg counts made in August were low.

It was interesting and unusual to note that early-instar larvae could be found in every jack pine stand examined in the northwest in 1969.

Trees were seriously defoliated and moths were numerous in parts of eastern Douglas County and west central Bayfield County, particularly in T45N, R10W; T46N, R9W; and T45N, R9W. Egg counts were high in the northern part of T45N, R9W and the southern part of T46N, R9W (Bayfield County). This may be a potential area for high populations in 1970.

Northeast

Aerial mapping of budworm defoliation in July, 1969 revealed that discernible defoliation had occurred on approximately 30,000 acres of jack pine in the northeast counties, excluding federal lands. Categories of defoliation and total acreage in each were as follows:

Heavy	9,690	acres
Medium	7,590	"
Light	12,800	"
Total	30,080	acres

Evidence of top-killing and tree mortality was present in some stands that had been hard-hit by the budworm since the current outbreak started near Conover (Vilas County) in 1966.

Changes in patterns and intensity of defoliation, and size and distribution of egg masses in six distinct areas of infestation indicate that budworm activity is generally waning throughout most of the jack pine type, but the insect will still be troublesome in a few localities in 1970.

Following are summaries of budworm conditions in each of six localities:

1. Conover (Vilas County) - 8,650 acres defoliated: light 780, moderate 6,190, heavy 1,680 acres. Much of the moderate defoliation area had been heavily defoliated in 1968. Twenty egg mass plots. Egg masses small on many plots, 1/4" to 1/2" long instead of 1" to 1 1/4". Eight plots with high counts, two moderate, ten light. Little evidence of egg parasitism. Outbreak in progress since 1966.

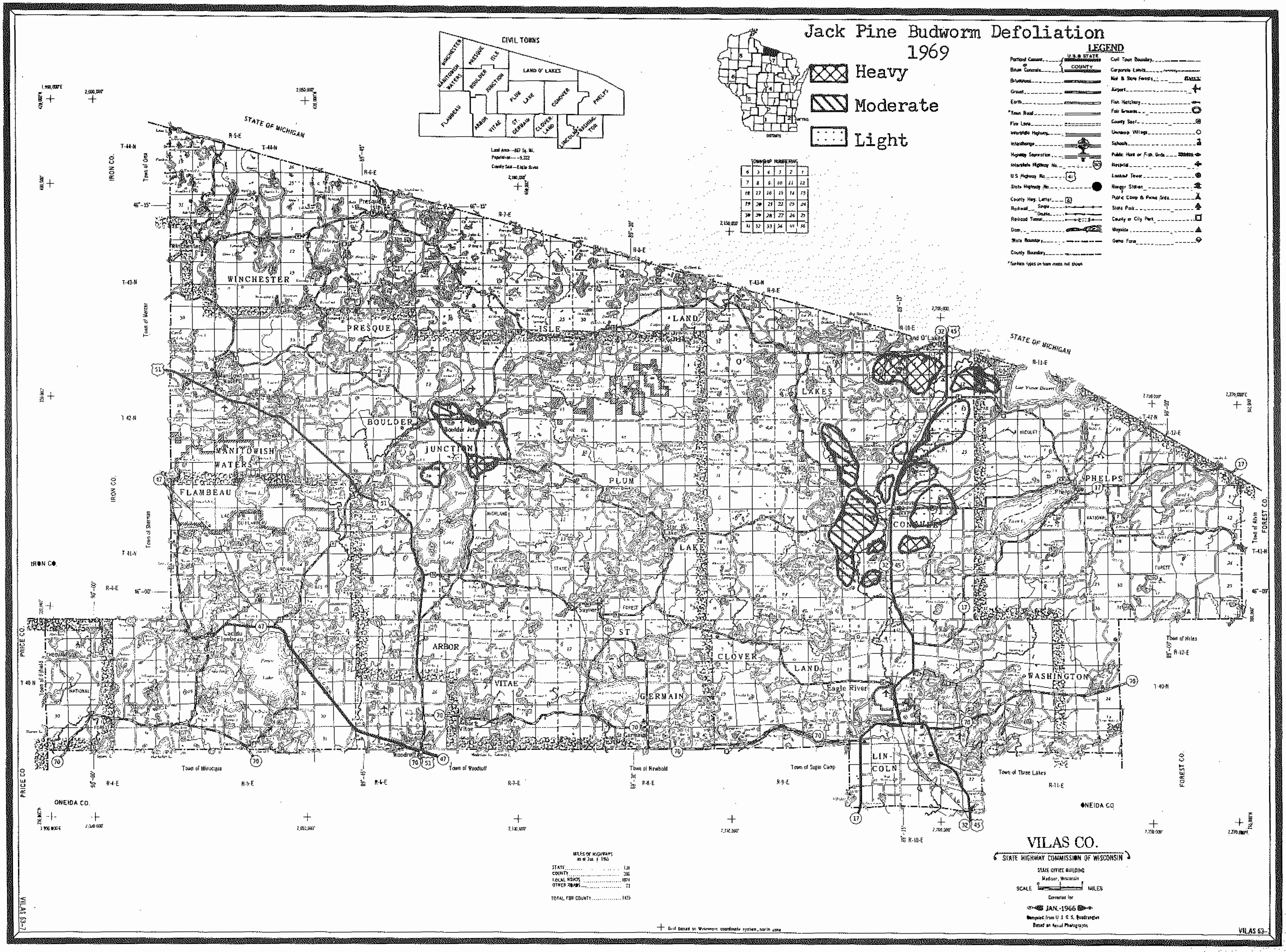
2. Trout Lake (Vilas County) - 2,520 acres defoliated: light 1,600, moderate 800, heavy 120 acres. Much of area outside stands treated in 1968 had light to moderate defoliation. Heavy defoliation occurred on two patches of timber of 80 and 40 acres respectively. 400 acres of light defoliation had not been attacked until this year. Fifteen egg mass plots...eight high, four moderate, three light. High egg counts were in timber along the periphery of previously infested stands. Outbreak started in 1967. 225 acres clear cut and 85 acres partially cut during winter of 1968-69, leaving mostly relatively young plantations.

3. NEPCO - Hazelhurst (Oneida County) - Total area defoliation increased by 1,500 acres over 1968 defoliation. 3,800 acres defoliated: 230 light, 1,350 moderate, 2,200 heavy. Defoliation in heavily infested area was very severe. Cutting of some timber recommended to minimize losses. Fifteen egg mass plots...two plots with high counts, 5 moderate, 8 light. Outbreak in second year.

4. Owens-Illinois and Lake Nokomis (Oneida County) - 4,290 acres defoliated: 420 light, 1,900 moderate, 1,970 heavy. Acreage of moderate to heavy defoliation increased over 1968 acreage. Fifteen egg mass plots...only one with high count. Outbreak in second year.

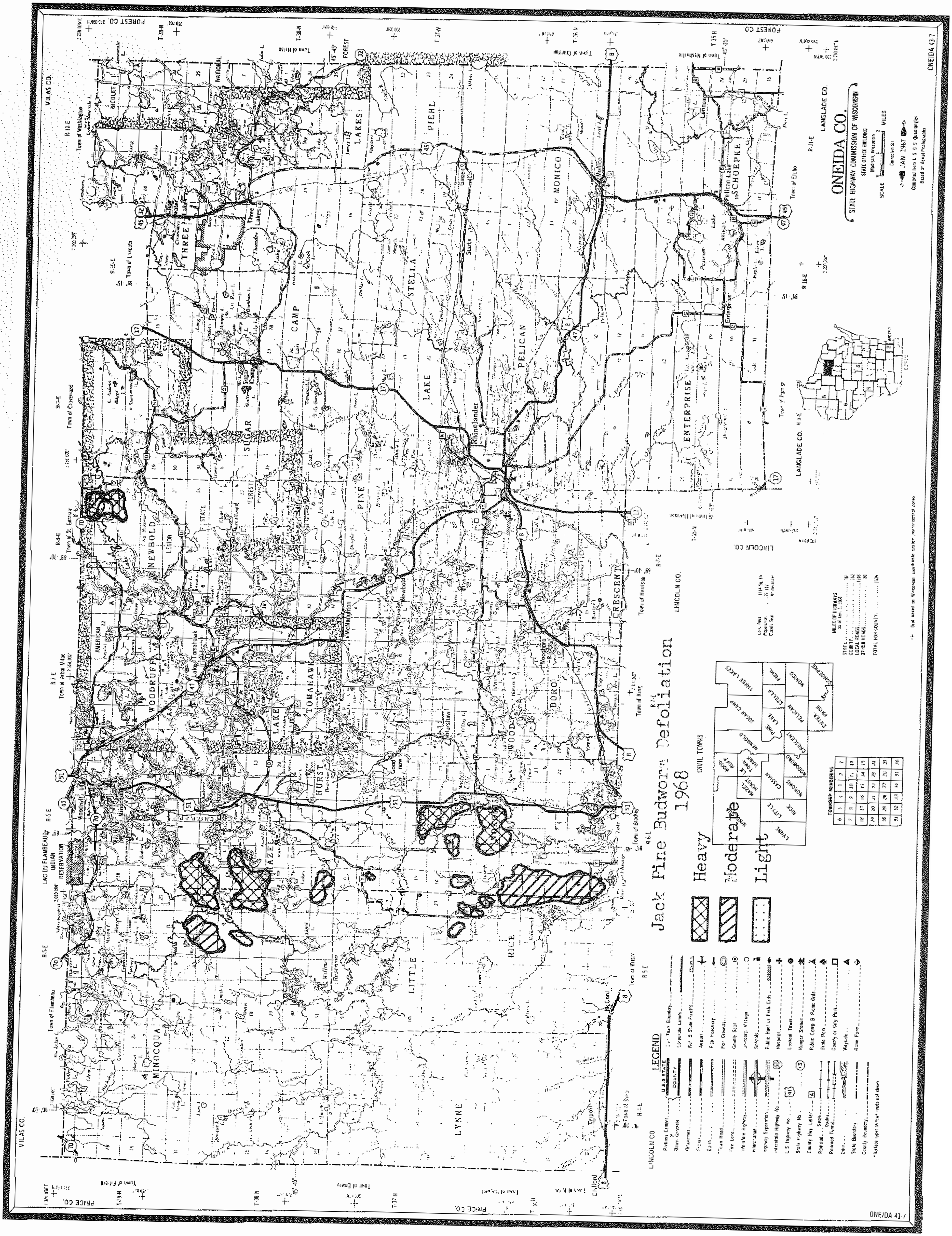
5. American Legion State Forest (Oneida County) - 2,400 acres defoliated: 500 light, 1,400 moderate, 500 heavy. First year with moderate to heavy defoliation. Stands consist primarily of young plantations. Nine egg mass plots...five with very high egg counts. Anticipate high budworm population in 1970. Outbreak in second year.

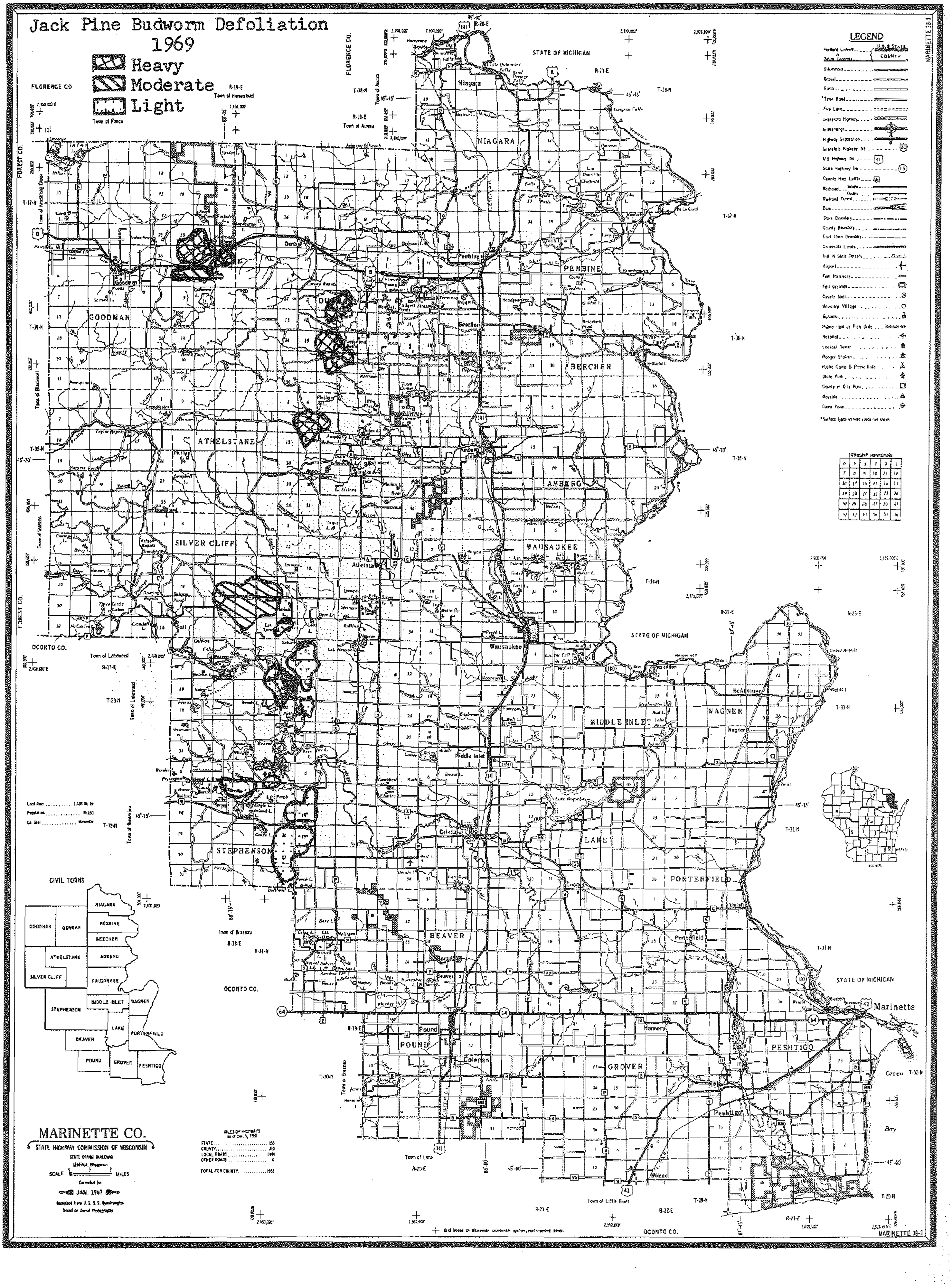
6. Marinette County - 8,420 acres defoliated: 4,060 light, 1,160 moderate, 3,200 heavy. Moderate to heavy defoliation occurred from Thunder Lake to Dunbar. Populations high in both natural stands and plantations. Little evidence of top-kill or tree mortality. Twenty egg mass plots...only three with high counts. Population appears to be dropping.



Jack Pine Budworm Defoliation 1969

Heavy
Moderate
Light
LEGEND
CIVIL TOWNS
STATE OF MICHIGAN
IRON CO.
PRICE CO.
ONEIDA CO.
FOREST CO.
WINCHESTER
PRESQUE ISLE
LAND O' LAKES
MANITOWISH WATERS
BOULDER JUNCTION
FLAMBEAU
PLUM LAKE
CONOVER
PHELPS
ARBOR VITAE
ST GERMAIN
CLOVER LAND
WASHINGTON
LINCOLN
Eagle River
VILAS CO.
STATE HIGHWAY COMMISSION OF WISCONSIN
STATE OFFICE BUILDING
Madison, Wisconsin
SCALE
MILES
JAN.-1966
Compiled from U.S.G.S. Quadrangles
Based on Aerial Photographs
VILAS 63-2


Jack Pine Budworm Defoliation
1968
Heavy
Moderate
Light
ONEIDA CO.
STATE HIGHWAY COMMISSION OF WISCONSIN
ONEIDA 43.7
LEGEND
CIVIL TOWNS
TOWNSHIP NUMBERING
THREE LAKES
SUGAR CAMP
STELLA
PIEHL
MONICO
SCHOEPKE
PELICAN
ENTERPRISE
LAKE
PINE
NEWBOLD
CRESCENT
WOODBORO
TOMAHAWK
LAKE TOMAHAWK
HAZELHURST
WOODRUFF
MINOCQUA
LITTLE RICE
LYNNE
Rhinelander
VILAS CO.
FOREST CO.
LANGLADE CO.
LINCOLN CO.
PRICE CO.
LAC DU FLAMBEAU INDIAN RESERVATION



Jack Pine Budworm Defoliation 1969

▨ Heavy

▨ Moderate

⬚ Light

MARINETTE CO.
STATE HIGHWAY COMMISSION OF WISCONSIN
JAN. 1967
LEGEND
CIVIL TOWNS
FLORENCE CO.
FOREST CO.
OCONTO CO.
STATE OF MICHIGAN
NIAGARA
DUNBAR
PEMBINE
GOODMAN
BEECHER
ATHELSTANE
AMBERG
SILVER CLIFF
WAUSAUKEE
MIDDLE INLET
WAGNER
STEPHENSON
LAKE
PORTERFIELD
BEAVER
POUND
GROVER
PESHTIGO
Niagara
Goodman
Amberg
Wausaukee
Middle Inlet
Crivitz
Pound
Coleman
Peshtigo
Porterfield
Marinette
Green Bay
MARINETTE 38-1

Land Descriptions With Evidence of Defoliation - Northeast

County	Area of Infestation	Total Acreage of Defoliation Mapped from Air	Descriptions Sections	Township	Range
Vilas	Conover	8,650	34	43N	10E
			23, 24, 25, 35, 36	42N	9E
			2, 3, 4, 9, 10, 11, 12, 13, 14, 15, 22, 23, 26, 27, 28, 30, 31, 32, 33, 34, 35	42N	10E
			7, 18	42N	11E
			1, 12, 13, 24, 25	41N	9E
			1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 15, 16, 17, 18, 19, 20, 29, 30	41N	10E
Vilas	Trout Lake	2,520	13, 24, 25 35, 36	42N	6E
			17, 18, 19, 20, 21, 27, 28, 29, 32, 33	42N	7E
Oneida	American Legion State Forest	2,500	1, 2, 3, 10, 11, 12, 13, 14, 15, 21, 22	39N	8E
Oneida	Hazelhurst	3,600	33, 34, 36	39N	5E
			31, 32	39N	6E
			1, 3, 4, 8, 9, 10, 11, 12, 13, 14, 15, 24	38N	5E

Land Descriptions With Evidence of Defoliation - Northeast (Cont.)

County	Area of Infestation	Total Acreage of Defoliation Mapped from Air	Descriptions Sections	Township	Range
Oneida	Hazelhurst		5, 6, 7, 8, 17, 18, 19	38N	6E
			35, 36	38N	5E
			31	38N	6E
			6, 7	37N	6E
Oneida	Lake Nokomis	4,290	35, 36	37N	5E
			21, 22, 27, 31, 32, 33, 34	37N	6E
			1, 12, 25	36N	5E
			2, 3, 4, 6, 7, 8, 9, 10, 18, 19, 30, 31	36N	6E
Marinette		4,820	8, 9, 16, 17, 20, 21, 28, 29	36N	19E
			7, 8, 18, 19	35N	19E
			31, 32, 33	37N	18E
			5, 6	36N	18E
			21, 22, 23, 24, 26, 27, 28, 33, 34, 36	34N	18E
			1, 12, 13, 24	33N	18E
			6, 7, 8, 19	33N	19E
			1, 2, 3, 4, 9, 10, 12, 13, 24, 25, 36	32N	18E
			7, 8, 17, 18, 19, 30, 31	32N	19E

West Central

Budworm populations were lower during 1969 than in 1968 in most jack pine stands in Jackson, Juneau and Monroe Counties, but were higher in two townships in Wood County (T21N, R5 and 6E) and in two adjacent townships in Adams County (T20N, R5 and 6E). Medium defoliation (light browning and thinned foliage) occurred on 5,000 to 10,000 acres of jack pine in these townships. Light defoliation was general in other jack pine areas.

No top killing or tree mortality is expected to result from 1969 defoliation. Some tree mortality and top killing occurred in Juneau County as a result of 1968 defoliation. Most severely affected were about 500 acres of plantation.

Egg surveys indicate lower budworm populations in most of the west central jack pine in 1970.

Phenological Notes:

May 13 - Budworm larvae inactive in Marinette County. Found one per 100 terminals examined. New growth 1/2" to 2" long. Little evidence of staminate flowers. Section 19, T32N, R18E. Oak leaves just beginning to show.

May 16 - First larvae found in Polk, Burnett, Washburn, Sawyer and southern Douglas Counties. Jack pine leaders 3" to 5" long, pollen hard and green.

May 19 - A few early 3d instar larvae in Jackson County. Budworm larvae feeding in Douglas and Bayfield Counties. Jack pine leaders 3" to 5" long and pollen hard.

May 21 - Active larvae observed from Polk to Bayfield County.

May 26 - Some 3d instar larvae in southern Douglas County. Pollen ripe. Jack pine leaders 3" to 7" long.

May 28 - Larvae mining in new needles in Vilas County. Approximately 95% second instar and 5% third instar. Third instar larvae found in few staminate flowers available. New growth on jack pine 1/2" to 3" long. Section 28, T42N, R10E.

June 2 - 70% second instar, 30% third instar in Marinette County. Larger larvae in staminate flowers. Staminate flowers rare in moderate to heavy defoliation areas, occasional flowers in light defoliation areas. Section 19, T32N, R18E.

June 3 - Most larvae in 2nd instar, a few in 3d in Polk County.

June 11 - Larvae 90% third instar, 10% second in a newly infested stand in Vilas County. Section 30, T41N, R10E.

June 16 - Larvae still second and third instars in Douglas County.

June 17 - Larvae mostly 3d, 4th and a few 5th instars in central Burnett County.

June 18 - Pupation starting in Juneau County. Larvae range from 3d to last instars.

June 19 - 75% 3d instar, 20% 2nd instar and 5% 4th instar in Oneida County. Considerable parasitism of larvae noted Section 18, T38N, R6E. First apanteles wasp found in southern Burnett County.

June 21 - 80% 3d, 10% 4th and a few 2nd instar larvae near Conover (Vilas County).

June 24 - Mostly 3d and 4th instars. Sections 31, 32, 36, T37N, R17-18E (Marinette County).

June 27 - Of 100 larvae examined in Marinette County, 10% 2nd instar, 40% 3d instar, 40% 4th instar and 10% 5th instar. Larvae average 2.5 per 15" of needle bearing surface on 40 plots (400 branches).

June 30 - Larvae in 3d, 4th and 5th instars in southwestern Douglas County.

July 5 - A few pupae observed in northern Douglas and southern Bayfield Counties.

July 9 - Pupation starting in Marinette County.

July 10 - Budworm about 40% pupated in Douglas County (T43N, R13W).

July 14 - Budworm 90% pupated in Douglas County. First adults found in Polk County.

July 16 - First moths in central Burnett County.

July 23 - First moths in Douglas County.

Pine Tussock Moth - _Dasychira plagiata_ (Walker)

Predicted tussock moth populations failed to materialize west of Wascott in T42N, R13W and T43N, R13W where egg counts were high the previous fall. Overwintering mortality, combined with parasitism, reduced the population so that little noticeable defoliation was evident. However, egg counts were high again in the fall of 1969 over 3,000 acres of jack pine in the same area. Fall feeding caused noticeable browning in some stands. Late instar larvae were also found on most budworm plots in Polk County and southern Burnett County, but eggs were not numerous in those counties. A few tussock moth cocoons were also observed on jack pine budworm spray evaluation check plots in Juneau County (Section 14, T20N, R4E), but no eggs or larvae were found.

Phenological Notes:

March 28 - Larvae collected this date showed evidence of white mold on April 9 when reared indoors (Paecylomyces).

April 21 - Larvae starting to break hibernation in Wascott area. A few had started feeding.

April 25 - Some larvae still not out of hibernation. Little evidence of feeding.

May 7 - A few 3d instar larvae noted. Larvae feeding very slowly.

May 12 - Larval mortality appears high in field.

May 26 - Larvae varied from 2nd to 5th instar. First Meteorus noted.

June 4 - A few larvae in the 6th instar, but mostly 4th and 5th.

June 26 - Larvae mostly 5th and 6th instars.

July 10 - 70% of larvae pupated (Section 34, 35, T43N, R13W).

July 14 - 85% of larvae pupated.

July 20 - First moths and eggs of the season found west of Wascott.

August 6 - Tussock moth eggs starting to hatch.

August 27 - Larvae starting to hibernate.

September 5 - A few larvae still feeding. Some browning of jack pine foliage due to fall feeding injury.

September 15 - All tussock moth larvae in hibernation.

Zimmerman Moth - Dioryctria zimmermani (Grote)

Continued to be a nuisance to Scots pine Christmas tree growers. Requests for control information were received from Wood County.

Elm Spanworm - Ennomos subsignarius (Hubner)

This defoliator was found feeding on broadleaf trees over several square miles of forest in northern Bayfield County (T48N, R8W and T49N, R7W). Oaks were severely defoliated in some locations and feeding was evident on red maple, elm, ironwood, cherry, birch and trembling aspen. Snow-white moths, with a dark spot on each wing, were very numerous in the Bayfield County defoliated area on July 31. New leaves were emerging on maple and oak. Ironwood buds were breaking. Big-tooth aspen was not defoliated. Identification of the insect was confirmed by University of Wisconsin taxonomists. Similar defoliation and insects were reported from T43N, R8W and T46N, R10W.

Jack-Pine Shoot Borer - Eucosma sonomana Kearfott

Damage continued at endemic levels in central county Scots and jack pine stands.

Aspen Blotch Miner - Lithocolletis tremuloidiella (Braun)

Caused severe injury to aspen leaves over an area of two townships south west of Land O' Lakes in Vilas County (T43N, R9E and T43N, R10E). About 2,000 acres of aspen heavily infested.

Eastern Tent Caterpillar - Malacosoma americanum (Fabricius)

An occasional tent was found on wild cherry trees along roadsides in Burnett and Washburn Counties.

A few tents were observed along roadsides in the west central counties. Most were noted in Jackson County (T22N, R5W and T21N, R4W). Although detailed observations were not made on individual colonies, some of them seemed to disappear before larval development was completed. Caterpillars were in the second and third instars in Jackson County on April 28. Larvae were 3/8" long on May 5.

Tents were observed in all east central counties along roads where wild cherry was present.

Forest Tent Caterpillar - Malacosoma disstria (Hubner)

A few colonies were reported on aspen in eastern Washburn County near Stone Lake (Section 11, T39N, R10W) on June 3. A single late instar caterpillar was observed in Wood County (Section 34, T21N, R4E) on June 18.

No further evidence of the insect has been observed or reported in the state.

European Pine Shoot Moth - Rhyacionia buoliana (Schiffermuller)

Populations remained low. An infestation was reported in a 5-acre red pine plantation in Door County (SWNW Section 15, T31N, R28E).

Spruce Needle Miner - Taniva albolineana (Kearfott)

The insect was abundant on ornamental spruce, particularly blue spruce, throughout the east central counties.

ORTHOPTERA

Walkingstick - Diapheromera femorata (Say)

Only an occasional walkingstick could be found in Douglas County (T43N, R13W) where the insects had been numerous last year. The insects were present in very small numbers in Jackson County where no defoliation was reported.

Defoliation was severe on 1,060 acres of scrub oak in the Town of Stephenson in Marinette County (Sections 20, 26, 33, 34 and 35, T33N, R19E). Walkingsticks were common on oak throughout the township but did not cause severe or complete defoliation elsewhere. Severe frost injury to new oak leaves occurred twice in early June over the northern and western parts of the county.

Phenological Note:

July 9 - Walkingsticks 1" long in Marinette County.

Post Oak Locust - Dendrotettix quercus (Packard)

This defoliator was frequently observed in several west central counties and in the Town of Stephenson in Marinette County, but no serious defoliation was observed anywhere.

Grasshoppers - Species undetermined

Two acres of a 30-acre spring planting of Scots pine in Jackson County (Section 19, T21N, R5W) sustained 50% to 90% loss by September 2, 1969.

Other Arthropods

Red spider mites were abundant on ornamental spruce in the Village of Minong and the City of Spooner (Washburn County).

Eriophyes mites severely attacked many tree and shrub species in the east central counties. They were epidemic in parts of Waupaca County where they caused leaf curl and premature leaf fall.

Black Flies - Simulium sp.

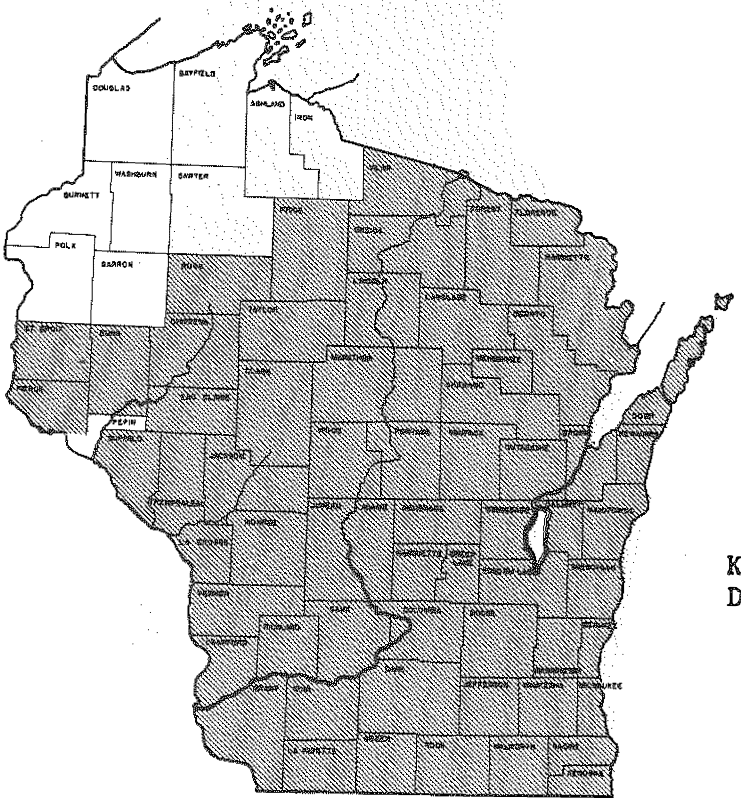
Heaviest population experienced in 35 years emerged in Menominee County on May 8. Virtually impossible to remain in woods. Annoying along west central county streams on May 19.

MAJOR FOREST DISEASES

WILTS AND DIEBACKS

Dutch Elm Disease - *Ceratocystis ulmi* (Buisman) Moreau

Dutch elm disease was reported in six new counties in 1969. The new counties reported in 1969 were Buffalo, Dunn, Pierce, Price, Rusk and Taylor. Dutch elm disease is now present in 62 of Wisconsin's 72 counties.



Known Distribution of
Dutch Elm Disease
1969

At Devil's Lake State Park (Sauk County) 95 elms were treated with Bidrin in 1967 and 9 were diseased at the end of the growing season. In 1968 the remaining 86 trees were again treated with Bidrin and 17 were infected at the end of the growing season. In 1969 the remaining 69 trees were treated for a third time and 17 died during the summer. Thus, 52 (55%) of the 95 elms treated from 1967 through 1969 remain.

A study was initiated in 1969 to determine if Dutch elm disease could be detected with aerial photographs before symptoms were observed on the ground. The survey which took place in the City of Madison and Menominee County involved the City of Madison Forestry Department, University of Wisconsin Civil Engineering Department and the Department of Natural Resources Forest Pest Control Section and Forest Survey Section.

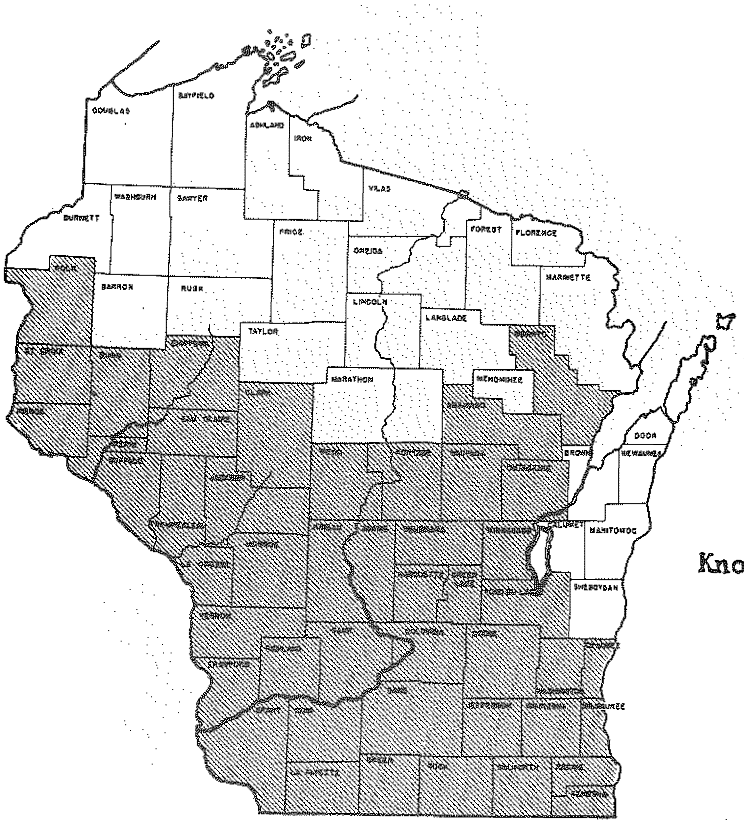
The University of Wisconsin Civil Engineering Department photographed an area in Madison at weekly intervals throughout the growing season with 35mm Agfachrome and Ektachrome Infrared Aero Film, Type 8443 at an altitude of 2,500 feet, while the City of Madison Dutch elm disease survey crews located diseased trees on the ground. The ground crews first detected Dutch elm disease infected trees on June 12 in the study area. The same trees were not observed on the photographs until July 15. However, the photographs did reveal infected trees that were never detected from the ground in 1969.

A detailed report concerning remote sensing for Dutch elm disease is being prepared by Mr. Alan Stevens, Civil Engineering Department, University of Wisconsin and Mr. Allen Prey, Forest Pathologist, Wisconsin Department of Natural Resources.

Aerial and ground surveys were continued in Menominee County to determine disease incidence and insect vector development. For example, a Dutch elm disease incidence survey was conducted on July 18, 1969. A Cessena Skylane was used at an altitude of 1,000 feet with flight lines one mile apart that alternated from north to south. Two observers mapped suspect trees which were later ground checked. Many of the trees ground checked were not elm but other species with chlorotic leaves. Also, several of the chlorotic or wilting elms were not infected with Dutch elm disease but were declining from other causes such as Armillaria mellea root rot. Also as part of the remote sensing study, aerial photographs were taken of four study areas in Menominee County with Ektachrome Infrared Aero Film, Agfachrome and Panchromatic film in an attempt to locate infected trees. The results will be included in the remote sensing report.

Oak Wilt - Ceratocystis fagacearum (Bretz) Hunt

There was no change in the statewide distribution of oak wilt in Wisconsin during 1969.


DOUGLAS
BAYFIELD
ASHLAND
IRON
VILAS
WASHBURN
SAWYER
BURNETT
PRICE
ONEIDA
FOREST
FLORENCE
MARINETTE
BARRON
RUSK
LINCOLN
LANGLADE
TAYLOR
MARATHON
MENOMINEE
DOOR
KEWAUNEE
BROWN
CALUMET
MANITOWOC
SHEBOYGAN

Known Distribution of
Oak Wilt
1969

ROOT ROTS

Annosus Root Rot - Fomes annosus (Fr.) Cke.

To date Fomes annosus root rot has not been found in Wisconsin. Numerous plantations have been examined statewide in the past seven years for the presence of F. annosus sporophores and root systems were examined for decay caused by F. annosus. In every plantation examined the results were negative.

Attempts were made to trap spores of F. annosus in the atmosphere from 1963-66 using pine foliage and cheesecloth spore traps as collecting devices. The spore collections were then incubated on freshly cut pine discs. Fomes annosus was never detected in any of the spore collections.

Tomentosus Root Rot - Polyporus tomentosus Fr.

A survey for Polyporus tomentosus was made in the fall of 1969. Thirteen plantations totaling 902 acres were surveyed. The plantations ranged from 19 to 54 years in age and all except one had been thinned. No sporophores were found in any of the plantations.

The following red pine plantations were surveyed for the presence of Polyporus tomentosus sporophores in October, 1969.

County & Owner	Approximate Acreage	Yr. Planted	Yr. Thinned
Iron (Village of Montreal)	60	1935	1961
Langlade			
T 33N, R10E, Sec. 13 (Co. Forest)	2	1939	1964
T 33N, R10E, Sec. 13 (Co. Forest)	50	1939	1969
T 31N, R11E, Sec. 33 (City	60	1936	1968
Marathon (Marathon Corporation)			
T 30N, R5E, Sec. 4 - NE NE	15	1938	None
Marinette (County Forest)			
T 32N, R19E, Sec. 19	50	1936	1967
Menominee			
T 28N, R15E, Sec. 22, 27	120	1936	1968
Oconto (County Forest)			
T27N, R20E, Sec. 4, 5, 7, 8	350	1935-40	1965-68
Vilas			
T 40, R11E, Sec. 25 (USFS)	10	1933-40	Various
Star Lake Plantations	25	1913	Various
Trout Lake Plantations	10	1913	Various
T 43-5, Sec. 33 (State Forest)	30	1935	1966
Waupaca (Hartman Creek State Park)			
T 21N, R11E, Sec. 6	120	1936-38	1964-69
	902 acres		

STEM AND BRANCH DISEASES

White Pine Blister Rust - Cronartium ribicola Fischer

Many requests were received concerning white pine ornamentals which were infected with blister rust. A majority of the requests were from people in the city of Shell Lake.

FOLIAGE DISEASES

Austrian Pine Needle Blight - Dothistroma pini Hulbray

This fungus rendered a 10-acre Christmas tree plantation of Austrian pine unmerchantable in 1968 in Waupaca County (SESE, Sec. 17, T25N, R11E). In July 1969 the landowner sprayed the trees with Bordeaux mixture (8-8-100) which protected the newly emerged needles and the appearance of the trees was noticeably improved. The landowner plans to treat the trees again in 1970.

Dothistroma pini continued to damage a year old Austrian pine plantation in Sauk County (S½ SW¼, Sec. 11, T8N, R3E). Adjacent red and Scotch pine were not infected (Figure 2). The known hosts of Dothistroma pini in Wisconsin are Austrian pine, Mugo pine and Ponderosa pine. Dothistroma pini was not found on jack, red, Scotch or white pine in Wisconsin.

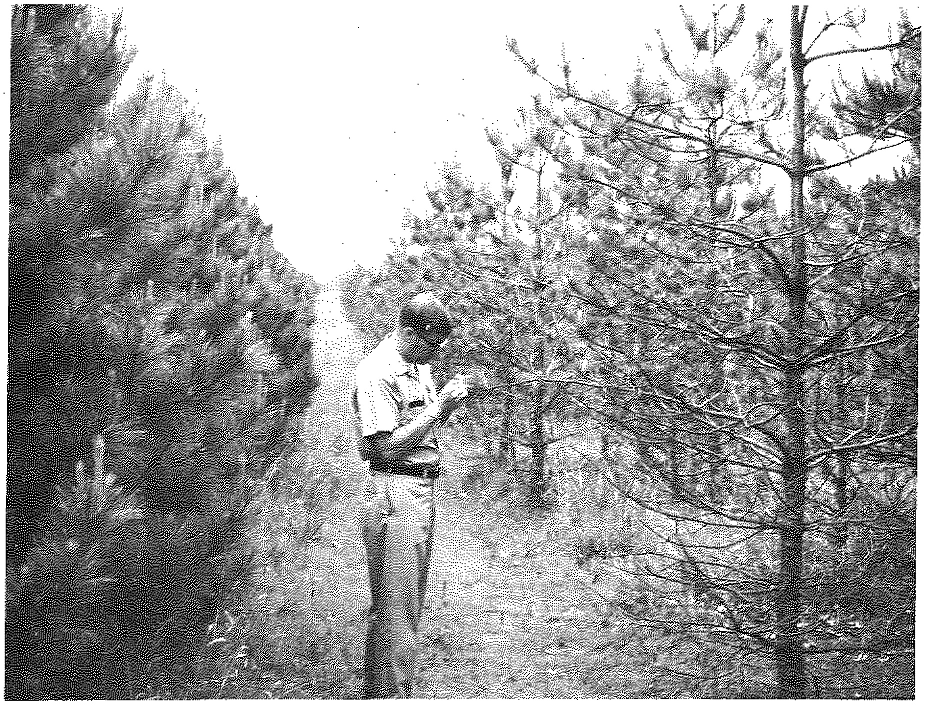


Figure 2 - Dothistroma pini on Austrian pine (right), adjacent red pine (left) is not affected. Photographed June 18, 1969 near Lone Rock, Wisconsin.

Brown Spot Needle Blight - *Lecanosticta acicola* (Thuem.) Syd.

Brown spot continued to damage Scotch pine Christmas trees in Wisconsin. The short needled French and Spanish varieties of Scotch pine were most severely affected. The disease was not observed on Austrian, jack, red or white pine in Wisconsin.

Lecanosticta acicola (Thuem.) Syd., the imperfect state of the brown spot needle fungus, *Scirrhia acicola* (Dearn.) Siggers, was first collected in Wisconsin in 1962 by Professor Robert F. Patton, Department of Plant Pathology, University of Wisconsin, Madison. The collection came from Scotch pine that was planted in 1913 in Vilas County (Star Lake Plantation, Lot 5, Section 15, T41N, R8E). The Scotch pine was grown from seed of unknown origin at the Trout Lake Nursery in 1911.

In 1966 the fungus was found in some Scotch pine Christmas tree plantations in Jackson County. Surveys made from 1967 through 1969 revealed that the disease was present in 12 counties in Wisconsin (Figure 3). The additional locations recorded in 1967 through 1969 did not necessarily indicate disease spread but were the results of more intensive surveys for the disease. The surveys did reveal that most of the infected plantations were planted from 1958 - 1961 with nursery stock from out-of-state sources. Younger plantations or those established from native grown seedlings were not infected. The one exception was a locally grown Scotch pine Christmas tree plantation in Columbia County (Sec. 10, T10W, R8E).

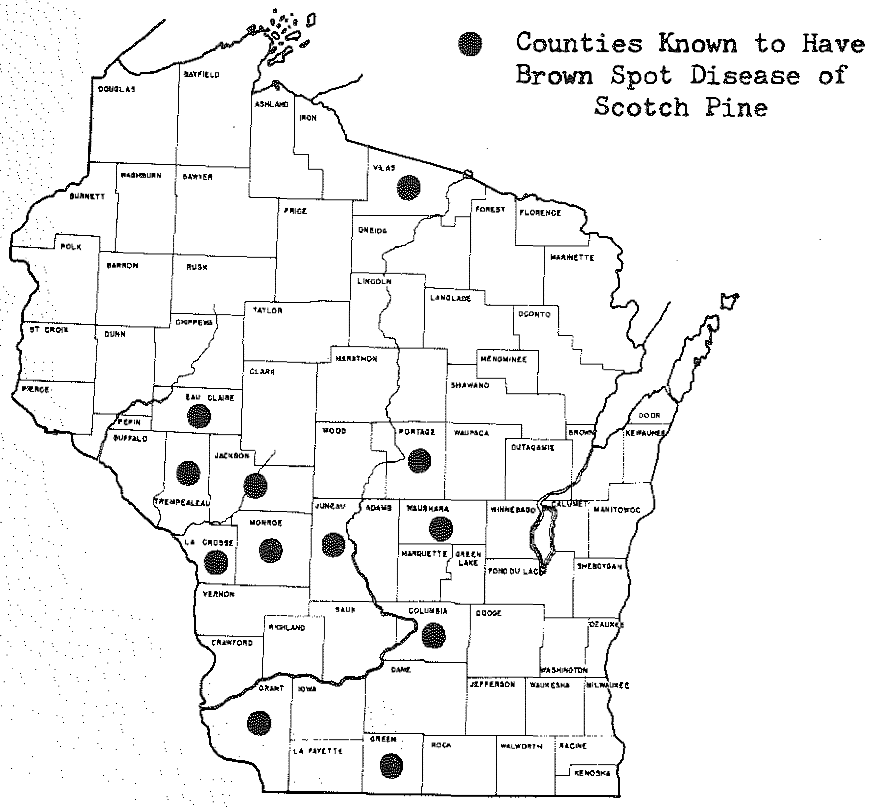

● Counties Known to Have Brown Spot Disease of Scotch Pine
DOUGLAS
BAYFIELD
ASHLAND
IRON
VILAS
BURNETT
WASHBURN
SAWYER
PRICE
ONEIDA
FOREST
FLORENCE
POLK
BARRON
RUSK
LINCOLN
LANGLADE
MARINETTE
TAYLOR
OCONTO
ST CROIX
DUNN
CHIPPEWA
MARATHON
MENOMINEE
CLARK
SHAWANO
PIERCE
EAU CLAIRE
PEPIN
BUFFALO
WOOD
PORTAGE
WAUPACA
BROWN
DOOR
KEWAUNEE
OUTAGAMIE
JACKSON
TREMPEALEAU
JUNEAU
ADAMS
WAUSHARA
WINNEBAGO
CALUMET
MANITOWOC
MONROE
LA CROSSE
MARQUETTE
GREEN LAKE
FOND DU LAC
SHEBOYGAN
VERNON
SAUK
COLUMBIA
DODGE
OZAUKEE
RICHLAND
CRAWFORD
DANE
WASHINGTON
GRANT
IOWA
JEFFERSON
WAUKESHA
MILWAUKEE
LA FAYETTE
GREEN
ROCK
WALWORTH
RACINE
KENOSHA

Figure 3 - Known county distribution of brown spot disease of Scotch pine in Wisconsin.

The perfect state, (Scirrhia acicola) of the brown spot fungus, was never recorded in surveys made in Wisconsin.

In the spring of 1969 experimental recommendations for the control of brown spot on Christmas trees in Wisconsin were developed and distributed to affected growers. Some growers sprayed their trees two or three times during the growing season with Bordeaux mixture (8-8-100) and protected the current year's needles.

In an attempt to find out more about the disease the Forest Pest Control Section established spore trapping stations and conducted experimental spraying with several fungicides. William T. McGrath, Professor of Forestry, Stephen F. Austin State College, Nacogdoches, Texas worked for the Pest Control Section in June and July of 1969. Professor McGrath recorded much of the spore trapping information. The results of the spore trappings and control trials were submitted for presentation at the Southwide Forest Disease Workshop to be held at Gainesville, Florida on January 20-21, 1970. The abstract submitted follows:

McGrath, W. T. and A. J. Prey (Stephen F. Austin State University, Nacogdoches, Texas, and Dept. of Natural Resources, Madison, Wisconsin respectively) Epidemiology and control of Lecanosticta acicola on Scotch pine Christmas trees in Wisconsin.

> Spore traps placed under infected trees in two Scotch pine Christmas tree plantations in west-central Wisconsin were checked weekly from April to December, 1969. Quantity of spore catch was compared with mean ambient temperatures, growth of new pine needles, and date and amount of precipitation. Initial discharge of conidia occurred in late May and seemed more closely related to time of pine budbreak than to precipitation and temperature; thereafter, conidial dissemination was positively correlated with rainfall. The perfect stage of the fungus was not found, either in infected needles on the trees or in dead needles on the ground.
>
> Lecanosticta acicola infection on 6-foot-tall Scotch pine Christmas trees was controlled by backpack mistblower applications of Bordeaux mixture (8-8-100 at 100 gal per acre) plus Dupont spreader-sticker, Daconil 2787 (6 lb/100 gal of water per acre), and Difolatan 4 flowable (6 lb/100 gal of water per acre). The fungicides were applied on June 10, July 7, and August 8. Control was excellent on trees that were sprayed on all three dates with any one of the fungicides. Acceptable control was obtained on trees that received just the June and July sprays, and also on trees that received only the July application. Similar applications of Dithane M-45 plus Dupont spreader-sticker did not give satisfactory control. Three (May, July, and August) fixed wing aircraft applications of Kocide 101 at 4 lb/3 gal of water per acre did not give satisfactory control.

The following is an evaluation of the backpack mistblower applications mentioned in the previous abstract. Evaluations were made on September 12, 1969.

Brown Spot Needle Blight Control Evaluation
Black River Falls, Wisconsin - 1969

	Difolatan 4 Flowable	Daconil 2787	Dithane M-45	Bordeaux Mixture (8-8-100)	Check
Schedule I (10 June only)	0.66	1.44	1.77	2.00	2.22
Schedule II (10 June, 7 July)	0.22	0.44	0.77	0.11	2.00
Schedule III (10 June, 7 July, 8 Aug.)	0.22	0.22	1.22	0.22	2.22
Schedule IV (7 July only)	0.44	0.88	1.66	0.66	2.22

Numerical Value	Damage Description	Narrative Standard
0 =	Light to None	0 = None or few damaged needles observed.
1 =	Light	1 = Few definitely infected needles. Control very satisfactory.
2 =	Medium	2 = Readily observed infected needles. Control unsatisfactory.
3 =	Heavy	3 = Infection easily observed on more than one branch. Control unsatisfactory.

FUNGICIDES

Difolatan 4 Flowable - Cis-N-((1, 1, 2, 2,-tetrachloroethyl) thio)-4-cyclohexene-1, 2-dicarboximide.

Daconil 2787 - 75W - Tetrachloroisophthalonitrile.

Dithane M-45 - 80W - A 80% coordination product of zinc ion and manganese ethylene bisdithio-carbamate containing Mn 16% and Zn 2%.

Bordeaux Mixture (8-8-100) - 8 lb. copper sulfate, 8 lb. hydrated lime in 100 gal. of water.

Known Locations of Brown Spot Needle Blight in Wisconsin - 1969

COUNTY	LOCATION	SCOTCH PINE (Acres)	REMARKS
Columbia	Sec. 10 T10W, R8E	5	
	Sec. 12 T10N, R8E	80	
Eau Claire	Sec. 9 T26N, R26W	20	
Grant	Sec. 18 & 19 T8N, R2W	20	
Green	Sec. 1 T1N, R9E	10	
Jackson	Sec. 31 T19N, R5W	20	
	Sec. 33 T19N, R5W	100	
	Sec. 28 T20N, R3W	40	
	Sec. 4 T20N, R3W	40	
	Sec. 7 T20N, R3W	20	Aerial sprayed with Kocide 101
	Sec. 5 T20N, R3W	30	
	Sec. 9 T20N, R3W	30	Ground sprayed with Bordeaux mixture 8-8-100
	Sec. 9 T20N, R3W	50	
	Sec. 1 T20N, R4W	5	Aerial sprayed with Kocide 101
	Sec. 7 & 8 T21N, R5W	20	
	Sec. 21 T21N, R5W	20	
	Sec. 27 & 28 T22N, R5W	30	
	Sec. 32 T22N, R5W	30	
	Sec. 17 T22N, R4W	20	
	Sec. 20 & 21 T23N, R5W	20	
	Sec. 32 T24N, R5W	60	Ground sprayed with Bordeaux mixture 8-8-100
	Sec. 25 T24N, R6W	80	Ground sprayed with Bordeaux mixture 8-8-100
	Sec. 11 T24N, R6W	20	
	Sec. 29 T24N, R5W	20	
Juneau	Sec. 2 T18N, R3E	20	
	Sec. 23 T18N, R3E	20	
LaCrosse	Sec. 4 T18N, R5W	60	
	Sec. 9 T18N, R5W	1	
Monroe	Sec. 28 T19N, R3W	80	Ground sprayed with Bordeaux mixture 8-8-100
	Sec. 25 T19N, R4W	30	
	Sec. 4 T19N, R4W	20	
Portage	Sec. 31 & 32 T21N, R10E	280	
	Sec. 32 T21N, R10E	30	
	Sec. 32 T21N, R10E	115	
	Sec. 33 T21N, R10E	119	
	Sec. 4 T22N, R7E	5	
Trempealeau	Sec. 9 & 16 T18N, R9W	40	
	Sec. 7 T24N, R7W	20	
Vilas	Sec. 15 T41N, R8E	5	

COUNTY	LOCATION		SCOTCH PINE (Acres)	REMARKS
Waushara	Sec. 26	T18N, R8E	60	
	Sec. 23	T18N, R8E	75	
	Sec. 16	T19N, R10E	88	
	Sec. 12	T19N, R9E	80	
	Sec. 11	T19N, R9E	155	
	Sec. 6	T19N, R9E	100	
	Sec. 4	T19N, R8E	80	
	Sec. 10	T20N, R10E	120	
	Sec. 8	T20N, R10E	154	
	Sec. 29	T20N, R10E	101	
	Sec. 3	T20N, R10E	120	
		Total	2,768	

Air Pollution

Trees and other vegetation on top of a bluff near Alma, Wisconsin (Buffalo County) continued to be damaged by sulfur dioxide fumes emitted from a coal-burning power plant in Alma. An aerial survey was made of the area on September 3, 1969. However, damage was not observed from the air nor did aerial photographs taken with 35mm Ektachrome Infrared Aero Film (Type 8443) or 35mm Kodachrome II reveal any damage. But an on-the-ground examination the same day at Buena Vista Park and the Devlin Denoff property (W½ NW¼ NE¼, Sec. 13, T21N, R13W) revealed damage to boxelder, basswood, white ash, white birch, alfalfa, burdock, raspberry, sumac and wild grape. No plant injury was observed at the base of the bluff within the city limits.

White pines in a plantation adjacent to the swimming pool at Pearl Lake in Waushara County (NENE Sec. 31, T19N, R12E) were damaged by escaping chlorine gas. Trees in the immediate vicinity were killed and others severely injured. The damage diminished as the distance from the source increased.

Balsam Fir Needle Rust - Uredinopsis spp.

Needle rust was reported as common on balsam fir Christmas trees in Langlade, Shawano and Iron Counties.

Ink Spot of Aspen - Ciborinia whetzelii (Seaver) Seaver

Light and scattered in the same general area as in 1968.

White Pine Needle Blight - Atmospheric Gases

White pine needle blight plots were again established in Green County at the Albany Public Hunting Grounds (SW¼ SE¼, Sec. 16, T3N, R9E). Needles within polyethylene bags were not blighted while needles outside the bags were blighted. Oxidant susceptible (Bel W-3) and resistant tobacco (Bel B) was planted at the Green County plots. The same tobacco varieties were also planted at Griffith Nursery, Wisconsin Rapids and Milwaukee County Nursery, Milwaukee. At all three areas the susceptible tobacco was weather flecked while resistant tobacco was not flecked.

NURSERY DISEASES

Black Walnut Root Rot - Cylindrocarpon radicicola Wr.

Root rot was again found to be a problem with black walnut seedlings grown at the Boscobel Nursery and lifted in 1969 for field planting. The disease was restricted to less than 5% of the plants. Major or initial infection appeared to be in the area where the nut was attached to the root. All seedlings were grown in soil that was fumigated with Mylone 50D at 400 lbs./acre.

Lophodermium Needle Cast - Lophodermium pinastri (Schrad.) Chev.

Lophodermium needle cast, which damaged red pine seedlings in previous years at Hugo Sauer Nursery at Rhinelander was controlled in 1969 by spraying the foliage with the fungicide Maneb (Figure 4). Experiments by the U. S. Forest Service, North Central Forest Experiment Station and Department of Natural Resources nursery managers indicate that more than one fungicide treatment during the growing season is necessary for complete control. Research on the number of sprays necessary for control will be completed by the end of 1970. On the basis of research results, Maneb was registered for needle cast control under the Federal Insecticide, Fungicide, and Rodenticide Act under Registration No. 352-291.

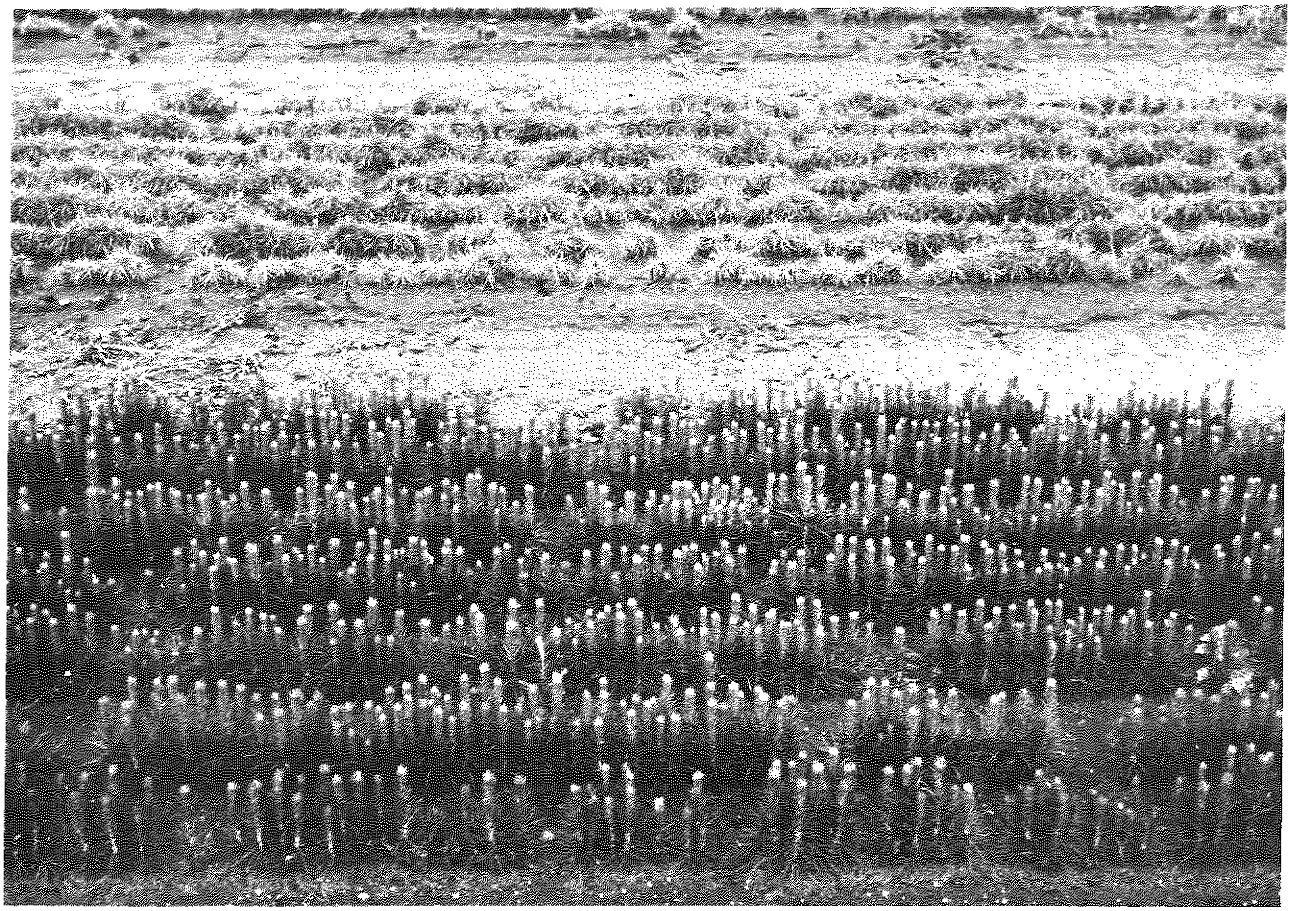


Figure 4 - Maneb-protected 2-0 red pine in the foreground with an untreated check plot in the background. Heavy mortality (up to 95 percent) occurred in the unprotected trees, as can be seen by the lack of terminal bud development. Photographed June 5, 1969 at the Hugo Sauer Nursery, Rhinelander, Wisconsin.

The Forest Service research suggested that infected red pine windbreaks may contribute to the buildup of Lophodermium in nursery beds. For example, infected windbreak needles with mature fruiting bodies were frequently blown into tree beds and thus may have provided a ready inoculum source for the buildup of the epidemic that started in 1966. Isolations made by Forest Service Pathologists from needles of red pine windbreaks at the Boscobel and Griffith Nurseries did not reveal any Lophodermium. However, Lophodermium was recovered from red pine windbreaks at the Hayward Nursery. As a result, the nursery used Maneb to protect its trees and no needle cast outbreak occurred in tree beds. Therefore, Forest Service Pathologists recommend that nursery windbreaks do not contain the same species being produced at the nursery.

OTHER

Snow Damage

Heavy snow and ice caused much damage to the lower limbs of pines, especially in younger red pine plantations. Some Christmas tree plantings were severely damaged or ruined due to broken branches.

Drought

Rather extensive areas of jack pine natural reproduction were found dead or dying in October. These were mostly on clear-cut areas, but some mortality was found under older stands. In some localities trees up to 15' high were dying, but in general it was mostly trees one to three feet tall. In some stands up to 90% of the reproduction is already dead.

Some locations -

Washburn County

T40N R13W - Sec. 3, 4, 10, 8
T41N R13W - Sec. 29, 32
T42N R13W - Sec. 6

Burnett County

T41N R16W - Sec. 13
T41N R15W - Sec. 10, 11, 1, 2, 25, 36

No indication of insect or disease damage could be found so possibly the very dry season caused complete desiccation of the trees. The mortality was not evident until late in the fall and most of the trees had completed their growth and some lammas shoots were evident.

Drought injury was also reported as being common on white birch in northeastern Wisconsin.

White pine Christmas trees were killed by drought at some locations in East Central Wisconsin.

THE NATIVE ELM BARK BEETLE IN NORTHERN WISCONSIN, 1968-69

by
Ray Weber, Technical Assistant
Forest Pest Control Section
Department of Natural Resources
Antigo, Wisconsin

November 1969

INTRODUCTION

The recent spread and intensification of Dutch elm disease into the commercial forest type of northern Wisconsin creates a new problem for some forest managers. The problem is of greatest concern in Menominee County, which contains approximately 116 million board feet of merchantable elm. The principal vector of the disease in northern Wisconsin is presumed to be the native elm bark beetle, *Hylurgopinus rufipes* (Eichh.). The smaller European elm bark beetle, *Scolytus multistriatus* (Marsh.), apparently is not present in this area. The distribution, feeding habits, and life history of the native elm bark beetle, particularly in large forest types, are not well documented. The writer was therefore employed on a part time basis during the summer of 1968 and 1969 in an effort to increase our knowledge of the species in this environment. Another objective of the investigations was to determine whether or not any elm logging practices or season of cutting might help to reduce the amount of suitable brood material.

An extensive survey in 1968 revealed that *H. rufipes* is an abundant species in the northeast area wherever elm material is available for brood purposes. Sampling indicated the population to be less abundant northward. It was noted that a tremendous population increase develops when abundant brood material becomes available as the result of elm logging or death of trees from Dutch elm disease. Detailed observations on the life history and habits were concentrated largely in Menominee County and adjacent portions of Langlade County.

Methods and Materials

Most of the information on the life history and feeding habits was obtained from field observations in areas where there was a large population of *H. rufipes* associated with an adequate number of living American elm trees. In most cases, there was sufficient dead and dying elm material, either as standing trees or in logging slash, to provide an abundant source of brood material. (Brood material is dead or dying elm, which remains attractive for ovipositing as long as the bark is tough and moist). Logging slash was by far the best for sampling purposes as the date that the brood material died is definitely known. Where it was necessary, more trees were felled to supply additional brood material of a known date.

There was no attempt to determine the exact length of egg, larval and pupal stages. Instead, particular attention was paid to those periods during which adults were emerging, flying to living elm trees, and feeding thereon.

This was accomplished in two ways: (1) by the use of one-foot square boards covered with Tanglefoot and placed on living elms in various situations. These Tanglefoot boards were fastened to the trunk at approximately six feet above the ground in such a manner that only those beetles flying to the tree would be trapped. The boards were changed at approximately one week intervals, and the trapped beetles counted, during the period from May through October 1969. (2) Samples of the bark were also removed from living trees at intervals throughout the season in order to observe the relative degree and location of feeding. No attempt was made to count the number of beetles in relation to bark area removed. Particular attention was paid, however, as to whether or not feeding tunnels extended to the xylems. Scoring of the xylem by beetle feeding is necessary, particularly when spring wood is being formed, in order to transmit Dutch elm disease.

Information on the seasonal development of H. rufipes was obtained by periodic removal and examination of bark from brood material of a known cutting date. The approximate period and abundance of each life stage was recorded for both the overwintering larvae and overwintering adult broods. Frequent bottle collections of each life stage were also made. No information was obtained on the hibernation period as the writer was not employed during November through April.

During August 1968 and June 1969, a total of twenty American elms with early disease symptoms were treated with Silvisar, a chemical silvicide produced by the Ansul Chemical Company. Treatment was applied in an effort to determine if the method would be useful either as a deterrent to beetle attack or to kill broods which might be established in the infected trees. (Use of the chemical in this manner was reported to be successful in controlling a serious Dendroctonus beetle outbreak in the western states). Treated elms ranged in size from 8" to 15" dbh. The chemical was applied in a series of axe cuts around the base of the trunk and extending into the xylem. Nearby elms of comparable size were used as controls by completely girdling the bole. An examination in late summer 1969 disclosed that all treated trees were successfully used as brood material by the native elm bark beetle. The degree of use was somewhat less than in the controls, but not enough to be a significant factor. In some instances, the lower part of the bole was not attacked, apparently because the bark became loose. When the treated trees were felled and examined, it was found that successful broods were produced in all higher parts of the tree including branches down to three inches in diameter.

Observations

The flight of adult beetles for feeding and hibernation purposes is shown in Table 1. The number of beetles per square foot represents collections from traps at the six foot level on elms located in open situations near an abundant source of brood material. Traps placed on elms in medium to dense underbrush produced so few beetles that they were not maintained. (Traps placed at higher elevations would probably have revealed that flight occurred above the dense understory). It will be noted that peak flight took place in early June, when elms are reported to be most susceptible to infection. The late fall flight is presumed to be primarily for hibernation purposes.

Periodic examination of bark samples from nearby elms substantiated the trap collections. Beetles could be found tunneling and feeding most commonly during the same periods. Feeding activity was commonly found to extend to the xylem, and appeared to be concentrated largely in the trunks of small trees and in limbs down to 2" in diameter.

As reported by other observers, there are two broods of the native elm bark beetle produced in northeastern Wisconsin. The major part of the population overwinters as adults in shallow hibernating tunnels in the bark of living elms. These appear to be concentrated largely in the lower part of the trunk of thick-barked trees. A minor part of the population overwinters primarily as larvae in dead elm material.

Brood galleries were found in all parts of dead elm material except in limbs less than approximately 3" in diameter. Galleries were most abundant on the shaded side of the trunk or limb, but less prevalent in material directly on the ground. Examination of trees cut during each month of the year revealed that all elm slash was used for brood purposes. Heaviest invasion took place by the overwintering adult brood in the period May through July in material cut during the dormant season. Late summer slash, however, was not attacked until the following spring. By then, much of it was invaded by fungi and other wood borers so that it was no longer as attractive for brood purposes. Slash more than a year old was seldom used for ovipositing.

Egg galleries were usually found across the grain between the bark and wood. They extended an average of 1½" in each direction from the entry hole. Each gallery contained up to 50 eggs which hatched within a five to ten-day period. Ovipositing in an individual gallery extended over a period of two to three weeks. Larval mines were up to three-fourths inch long before a complete hatch of eggs occurred at the distal end. Dead mature adults were frequently found at the end of the egg gallery. Pupation occurred in pupal cells at the end of the larval gallery and nearer to the bark surface. Adult emergence took place through holes chewed directly to the outer bark surface.

The seasonal development of each brood is shown diagrammatically in Figure 5. Conclusions on the life history of each brood are as follows:

Overwintering Adult Brood

By May 1, 1969, when the first observations were made, overwintering adults were seldom found in hibernating tunnels. Apparently, most had already emerged to feed. Although the earliest egg galleries were observed by May 1, the peak of ovipositing does not occur until late in the month and continues at a high level through June. Some early adults emerge and feed beginning in late July. After feeding, they enter new brood material and establish egg galleries. Resulting larvae do not complete their development, pupate, and emerge as adults until the following June and early July. Late adults, on the other hand, continue to emerge and feed throughout late summer and fall and then enter living elms for hibernation. A few retarded spring larvae fail to complete their development during the current season. Thus, the overwintering adult population produces one full generation plus a minor partial generation.

Overwintering Larval Brood

Adults developing from this brood emerge in July and early August, feed, and then establish broods. These late summer adults begin emerging in mid-September, fly to nearby living elms, and chew into the bark to feed and hibernate. A minor part of this brood, however, remains in the larval and pupal stage for overwintering. Thus, similar to the overwintering adult brood, part of this brood produces a full and a partial second generation. Pupae and young adults, which remain in brood material throughout the winter, rarely survive until spring. Numerous dead individuals of these stages are found in brood material examined in the spring.

No significant amount of predation was observed in the thousands of brood galleries examined during the two-year period. Species generally found, however, are a Hister beetle and a psuedoscorpion. Mites and elm weevil larvae are also common in brood galleries.

Status of Dutch Elm Disease in Menominee County

The map on page 44 shows the spread of Dutch elm disease in the county since it was first reported two years ago. Although only nine trees were located in 1967, the disease was probably well established for several years, particularly along the Wolf River. The area of general infection is where the disease was so well established by 1969 that trees with obvious symptoms could readily be found. Within this area it is especially severe around swamps and fields, and along streams where elms are concentrated. The reasons for the rapid spread and intensification in such environments is not definitely known, but it is probably due to a combination of several factors:

1. The occurrence of elm as the most abundant species in swamp hardwood types. Thus, more accessible feeding area is available for the insect vector. Intensification of the disease is also possible through root grafts.

2. The higher incidence of dead and dying elms from other causes provides a continual abundance of brood material.

3. The open nature of the elm type provides a relatively unobstructed flyway for the beetle to transmit the disease through its feeding habits.

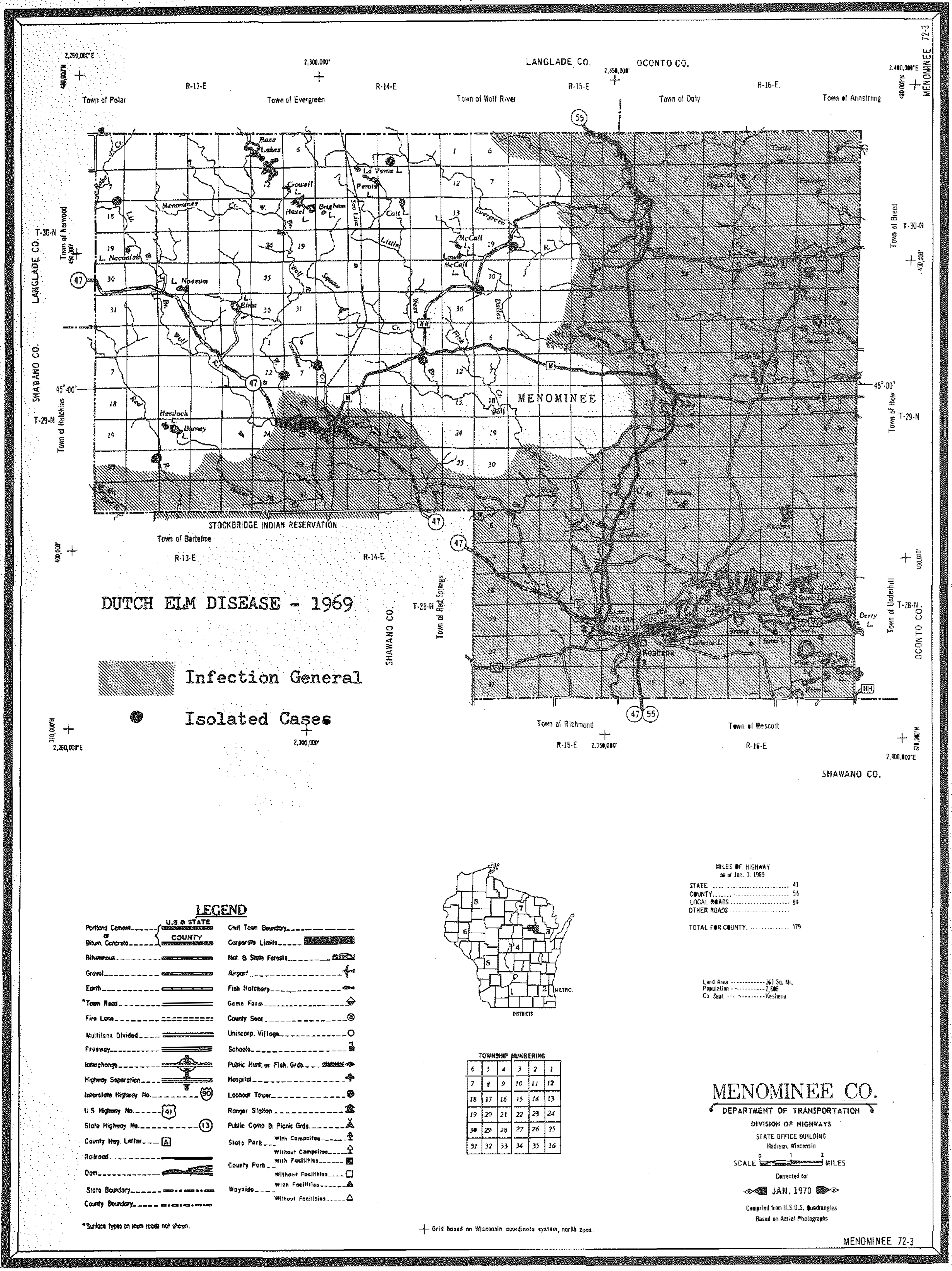
4. The relatively low crowns, compared to elms in a mixed northern hardwood type. Thus, more accessible feeding area is available for possible infection.

The adult beetle is seldom able to penetrate to the xylem of thick-barked trees during the spring feeding or winter hibernation period. This fact may explain why sawlog trees with a high crown may not become infected as readily as smaller or low-crowned trees. Large trees with a low crown, however, could be readily infected by beetle feeding in the lower branches.

Since there is no precedent for Dutch elm disease spread rate and pattern in a large mixed hardwood type, future losses of valuable saw timber in the

Menominee forest cannot be predicted. In order to harvest trees ahead of possible losses from Dutch elm disease, the allowable cut of elm has been reduced from 24" to 18" dbh. If the future spread continues to be limited largely to trees under 18", the lowering of allowable cut may prematurely liquidate more growing stock than the disease. Under the circumstances, it would appear advisable to maintain a continuous sampling of affected trees by dbh and compartments until the question is resolved.

Thus far, the disease has been confined to American and slippery elm. Only one positive case has been found in rock elm and that apparently is a root graft. This species constitutes approximately thirty percent of the total elm volume. Susceptibility of rock elm under natural conditions, where H. rufipes is the only known vector, has not been investigated. The degree of beetle feeding preference, and ability to score the xylem, if any, should therefore be considered. This could be accomplished under field conditions by maintaining a record of disease incidence in this species compared to American elm growing in the same environment.



DUTCH ELM DISEASE - 1969

▨ Infection General

● Isolated Cases

MENOMINEE 72-3
LANGLADE CO.
OCONTO CO.
SHAWANO CO.
MENOMINEE
R-13-E
R-14-E
R-15-E
R-16-E
T-30-N
T-29-N
T-28-N
Town of Polar
Town of Evergreen
Town of Wolf River
Town of Doty
Town of Armstrong
Town of Norwood
Town of Hutchins
Town of Bartelme
Town of Red Springs
Town of Richmond
Town of Wescott
Town of Breed
Town of How
Town of Underhill
STOCKBRIDGE INDIAN RESERVATION
45°-00'
Keshena
Keshena Falls
Bass Lakes
La Verne L.
Crowell L.
Hazel L.
Brigham L.
Perote L.
Coll L.
McCall L.
L. Neconish
L. Nosewm
L. Elm
Hemlock L.
Berry L.
Wolf R.
Evergreen R.
Red R.
55
47
47/55
LEGEND
U.S. & STATE
COUNTY
Portland Cement or Bitum. Concrete
Bituminous
Gravel
Earth
*Town Road
Fire Lane
Multilane Divided
Freeway
Interchange
Highway Separation
Interstate Highway No.
U.S. Highway No.
State Highway No.
County Hwy. Letter
Railroad
Dam
State Boundary
County Boundary
Civil Town Boundary
Corporate Limits
Nat. & State Forests
Airport
Fish Hatchery
Game Farm
County Seat
Unincorp. Village
Schools
Public Hunt. or Fish. Grds.
Hospital
Lookout Tower
Ranger Station
Public Camp & Picnic Grds.
State Park - With Campsites / Without Campsites
County Park - With Facilities / Without Facilities
Wayside - With Facilities / Without Facilities
*Surface types on town roads not shown.
DISTRICTS
METRO.
TOWNSHIP NUMBERING
+ Grid based on Wisconsin coordinate system, north zone.
MENOMINEE CO.
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STATE OFFICE BUILDING
Madison, Wisconsin
SCALE 0 1 2 MILES
Corrected for
JAN. 1970
Compiled from U.S.G.S. Quadrangles
Based on Aerial Photographs

TOWNSHIP NUMBERING

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

MILES OF HIGHWAY
as of Jan. 1, 1969

STATE	41
COUNTY	54
LOCAL ROADS	84
OTHER ROADS	
TOTAL FOR COUNTY	179

Land Area	361 Sq. Mi.
Population	2,606
Co. Seat	Keshena

Figure 5

Diagrammatic Representation of the Life History of Hylurgopinus rufipes (Eichoff) in Northeast Wisconsin 1969

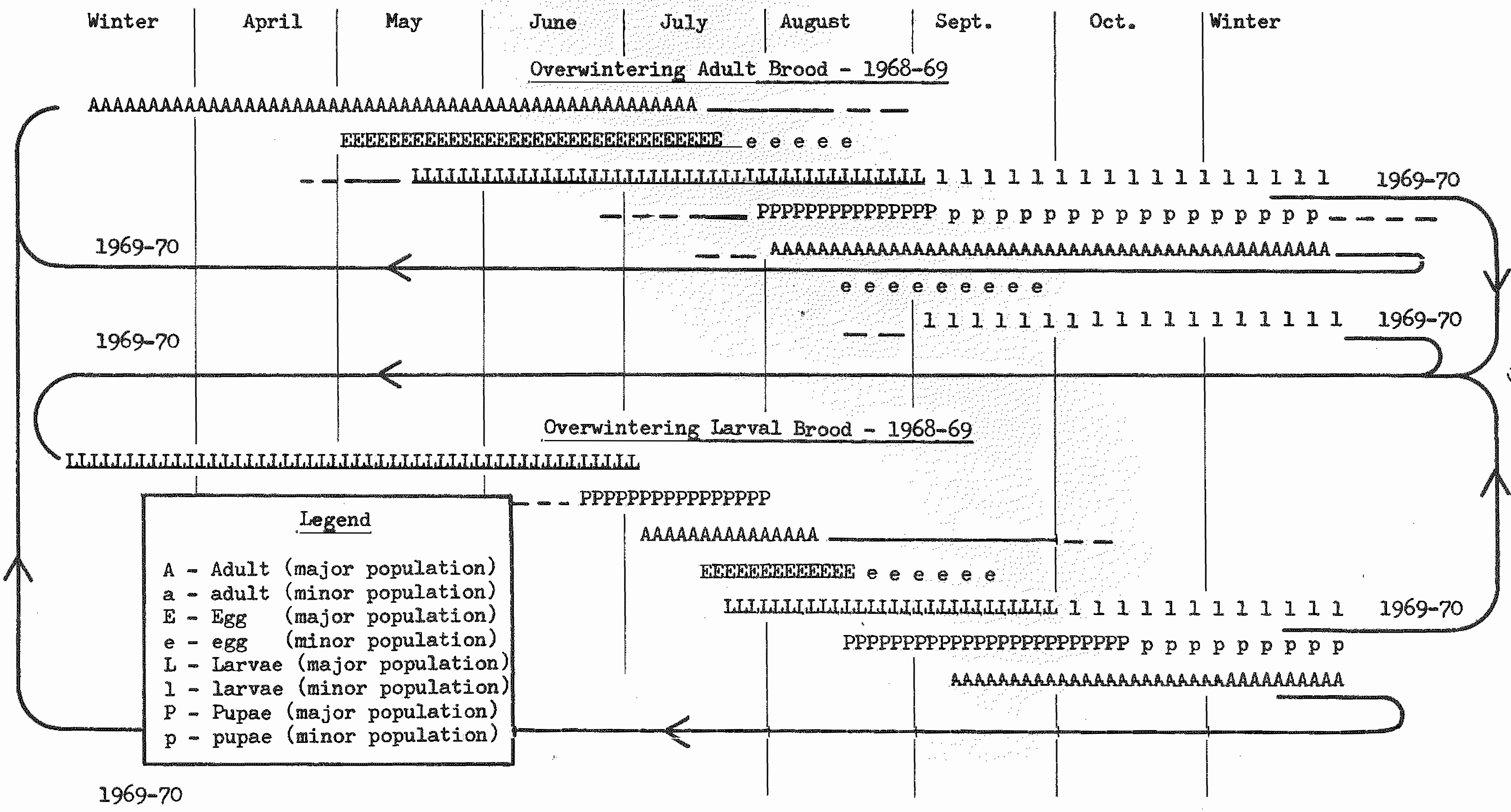

Winter
April
May
June
July
August
Sept.
Oct.
Winter
Overwintering Adult Brood - 1968-69
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE e e e e e
LLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLL l l l l l l l l l l l l l l l l l l
1969-70
PPPPPPPPPPPPPPP p p p p p p p p p p p p p p p p
1969-70
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
e e e e e e e e e
l l l l l l l l l l l l l l l l l l
1969-70
1969-70
Overwintering Larval Brood - 1968-69
LLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLL
PPPPPPPPPPPPPPPP
AAAAAAAAAAAAAAA
EEEEEEEEEEEEEE e e e e e e
LLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLL l l l l l l l l l l l l
1969-70
PPPPPPPPPPPPPPPPPPPPPPPPP p p p p p p p p p
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
Legend
A - Adult (major population)
a - adult (minor population)
E - Egg (major population)
e - egg (minor population)
L - Larvae (major population)
l - larvae (minor population)
P - Pupae (major population)
p - pupae (minor population)
1969-70

Table 1. Native Elm Bark Beetle Collections Per Square Foot From Tanglefoot Traps Placed on Living Elms - Menominee County - 1969

Exposure		Number of Beetles	
Period	Days	Total	Av./Day
5/5-28	23	7	0.3
5/28-6/5	7	28	4.0 (1)
6/5-13	8	6	0.8
6/13-20	7	5	0.7
6/20-30	10	5	0.5
6/30-7/9	9	4	0.4
7/10-18	8	13	1.6 (2)
7/18-28	10	3	0.3
7/28-8/4	7	0	0.0
8/4-11	7	1	0.1
8/11-19	8	3	0.4
8/19-27	8	1	0.4
8/27-9/3	7	4	0.6
9/3-10	7	2	0.3
9/10-17	7	11	1.6 (3)
9/17-25	8	7	0.9
9/25-10/1	6	0	0.0
10/1-7	6	2	0.3
10/7-20	13	17	1.3 (4)
10/20-30	10	2	0.2

(1) Peak Spring flight of overwintering adults

(2) Peak Summer flight of overwintering larval brood

(3) Peak Fall flight of progeny from overwintering adult brood

(4) Peak Late Fall flight of adults for feeding and hibernation

Native Elm Bark Beetle - Hylurgopinus rufipes

Phenological Notes: (All from Menominee County, except as noted)

May 1 - Section 2, T29N, R15E. Elm buds beginning to break dormancy. Overwintering adults abundant in hibernation tunnels in the bark of living elms. Some adult emergence has occurred, particularly from the south side of tree trunks.

Nearly mature larvae (from 1968 summer brood) are present in trap logs cut in June 1968.

May 5 - 9 - Section 24, T30N, R16E. Elm leaves up to 1/4" long. Breeding pairs of overwintering beetles observed in nuptial chambers. Egg laying well advanced by May 5, probably began in late April. Favored early spring brood material is standing elm which died in 1968. Very few overwintering adults remain in hibernation and feeding tunnels in living elms. Favored overwintering material appears to be certain elms near water.

Only well developed overwintering larvae now present in brood material. Most pupae and callow adults present at time of observation in mid-November 1968 apparently died prior to first spring examination on May 5th.

May 13 - Section 24, T30N, R16E. Elm leaves up to 1/2" long. Egg laying by overwintering adults completed in a few galleries but just commencing in most brood material.

Overwintering larvae in advanced stages of development. Examination of numerous overwintering larval sites indicated that the few larvae present in the material in mid-November failed to develop. Many dead pupae noted. Apparently molds invade larval galleries in old brood material before late larvae can mature.

May 15 - Section 24, T30N, R16E. Elm leaves up to 3/4" long. Many hibernating adults remain in rough-barked stumps and logs, but most have emerged from thin-barked elms.

First 1969 eggs hatched on south side of trunk of large elm, but no larval mines started (event about 1 month earlier than in 1968). Egg galleries started in slash from winter of 1968-69 logging. Numerous feeding adults and tunnels found in low limbs (2" - 4" diameter) of living elms. Most appear to score the xylem.

May 16 - Section 24, T30N, R16E. Observations on beetle activity in large elm stumps from logging during winter of 1968-69. Heavy concentrations of adults in hibernation tunnels in rough bark. Very heavy adult invasion of inner bark at edge of saw cuts... apparently attracted by sap exudation at this point. No egg galleries noted but many adults appear to be tunneling toward xylem.

June 6 - Section 24, T30N, R16E. Egg laying by overwintering adults now reaching its peak in most suitable brood material...just starting in logs and tops from March, 1969 cutting. Larval mines up to 1" long from eggs deposited about May 1 in south side of standing tree that died in 1968. Eggs were deposited by early-emerging overwintering adults. Very few adults now found feeding in branches of healthy elms. However, collections still abundant on tanglefoot traps placed weekly on healthy elms. Dutch elm disease could readily be transmitted by current movement and feeding of overwintering adults while spring wood is being formed.

Overwintering larvae are relatively scarce compared to overwintering adults. No pupae noted but most larvae appear to be mature.

June 6 - Section 23, T29N, R13E. Overwintering adults started laying eggs in late July and early August, 1968 slash which still has tight bark. No oviposition occurring where bark sloughs off readily due to heavy invasion by other borers and fungi. September 1968 slash being heavily invaded by ovipositing adults...bark still mostly tight and moist. Heavy invasion of dying trees afflicted with Dutch elm disease by egg-laying adults.

Overwintering larvae appear mature but no pupae observed.

June 12 - Section 23, T29N, R9E. Dutch elm disease symptoms abundant along Eau Claire River in Marathon County. Native elm bark beetles abundant in trees with advanced disease symptoms. Numerous egg galleries and new larval mines up to 1" long.

Similar conditions observed near Mosinee (Marathon County). 65 brood trees checked. No smaller European elm bark beetles found. Native beetle only present.

June 20 - Section 24, T30N, R16E. Overwintering adults still laying eggs, but most 1969 eggs have hatched. Larvae to 1/8" long and larval mines up to 1 1/2". Adults still being trapped on tanglefoot boards placed on healthy elms weekly. Hibernation and feeding tunnels reaching the xylem are commonly found in trunks of decadent elms along watercourses. This is rarely observed in healthy elms growing among other hardwoods on uplands.

About 60% of overwintering larvae have transformed to pupae. Many dead adults and pupae which failed to survive the winter observed. This segment of overwintering beetles scarce in numbers.

Crown symptoms of disease are becoming conspicuous, particularly where the disease is already known to have been present in past years.

July 1 - Overwintering adults oviposited all during June in suitable brood material...an extension of the disease was located in northwestern Menominee County at the junction of Highway 47 and the Little West Branch of the Wolf River...SESE Section 29, T30N, R13E.

One township remains in Menominee County where the disease has not been found, T30N, R14E.

July 10 - Section 28, T28N, R15E and Section 24, T30N, R16E. Egg laying by overwintering adults still in progress. Larvae from first 1969 eggs are mature but no pupation observed. Flying adults still being collected on tanglefoot traps placed weekly on healthy elms.

Overwintering larval stage now 60% pupated, 35% still larvae, remainder callow adults in pupal chambers.

July 28 - Section 28, T28N, R15E and Section 24, T30N, R16E. Overwintering adults still ovipositing in suitable brood material, but most progeny are in larval stages.

Overwintering larval stages no longer found in brood material under observation. All pupae and some young adults present and emerging.

August 1 - Dutch elm disease now confirmed in all Menominee County townships. Beetle populations continue to be high wherever suitable brood material is present, and more becomes available as trees are killed by the disease. Nearly all elm slash is heavily utilized. Even isolated dead and dying elms in the northern hardwood type are found and used by the beetles for breeding sites. The potential is present for continued intensification of losses from DED in high value sawlog timber.

August 11 - Section 24, T30N, R16E. Brood now developed to 60% larvae, 30% pupae, and 10% young adults from first eggs found May 1. Little adult emergence so far.

Emergence of adults reared from overwintering larvae is practically complete in brood wood under observation.

August 27 - Section 24, T30N, R16E. Adults now mostly emerged from spring 1969 eggs. A few larvae, pupae, and young adults still in brood material.

Adults from overwintering larvae completely emerged and new egg galleries are being produced in suitable brood material.

September 1 - By late August dry weather conditions caused much premature flagging and yellowing of elms masking disease symptoms. Practically all infection to date in northern hardwood type in Menominee County has been confined to American elm less than 18" dbh.

One infected rock elm has been located in the county and appears to be a root graft infection from an adjacent American elm.

September 10 - Section 24, T30N, R16E. Progeny from overwintering adult brood now reaching peak of emergence as adults. Those from late oviposition are still in various larval stages.

Adult progeny from overwintering larvae have formed egg galleries and some of their eggs have hatched. Numerous mature adults also found in feeding tunnels in bark of living American elms, particularly where beetle population is high.

September 16 - Section 24, T30N, R16E. Early progeny from overwintering adults largely emerged and these adults are continuing to invade living elm bark to feed. 11 adults per square foot per week were trapped on tanglefoot boards. Some egg galleries were being formed in suitable brood material. Most progeny from the overwintering adults are still in late larval, pupal or young adult stages of development.

Larvae from adults which emerged in August are now up to 1/8" long, and larval galleries are up to 1 1/2" long.

October 8 - Progeny from overwintering larvae which became adults in late June and July have produced another generation...overwintering adults. Some from late eggs are still in the larval stage and will go into the winter in their brood galleries.

Progeny from overwintering adults (adults which laid eggs in early May) have mostly transformed to mature adults and entered hibernation tunnels in living elms by October 1. Early adults started laying eggs in late August, some of these have hatched and produced an early larval stage (partial second generation) which will overwinter as larvae.

CHEMICAL CONTROL

INSECTICIDE EVALUATION FOR CONTROL OF JACK-PINE BUDWORM IN WISCONSIN - 1969

Four insecticides were used in tests against the jack-pine budworm in Wisconsin in 1969. The tests were a cooperative effort involving the Department, the University of Wisconsin Department of Entomology, and suppliers of the test insecticides Gardona, Landrin, Matacil, and Sevin.

Test Sites

Test sites were selected on the basis of adequate larval populations in the desired stages of development, and availability of infested jack-pine foliage that could readily be sampled from the ground. Two twenty-acre blocks were selected for treatment with each chemical, at one rate of application, in Juneau County. They were located on County Forest, Nekoosa-Edwards Paper Company and Wisconsin River Power Company lands. See map on page 52. Two forty-acre blocks of timber were selected in Marinette County for a second test of Landrin.

Test sites for each chemical were located to provide maximum available separation between different treatments, usually one mile.

Evaluation

Sampling points for pre-and post-spray population evaluation were laid out at one-chain intervals (66 ft.) diagonally across flight lines in a "V"-shaped pattern. Each leg of the "V" was a ten-station replication. Ten twigs, each with 15 inches of needle-bearing surface, were clipped from at least five different trees at each of the twenty sampling points. Budworms on each twig were counted and recorded in pre-and post-spray counts. Post spray counts were made along the same courses and at the same stations approximately 72 hours after an insecticide was

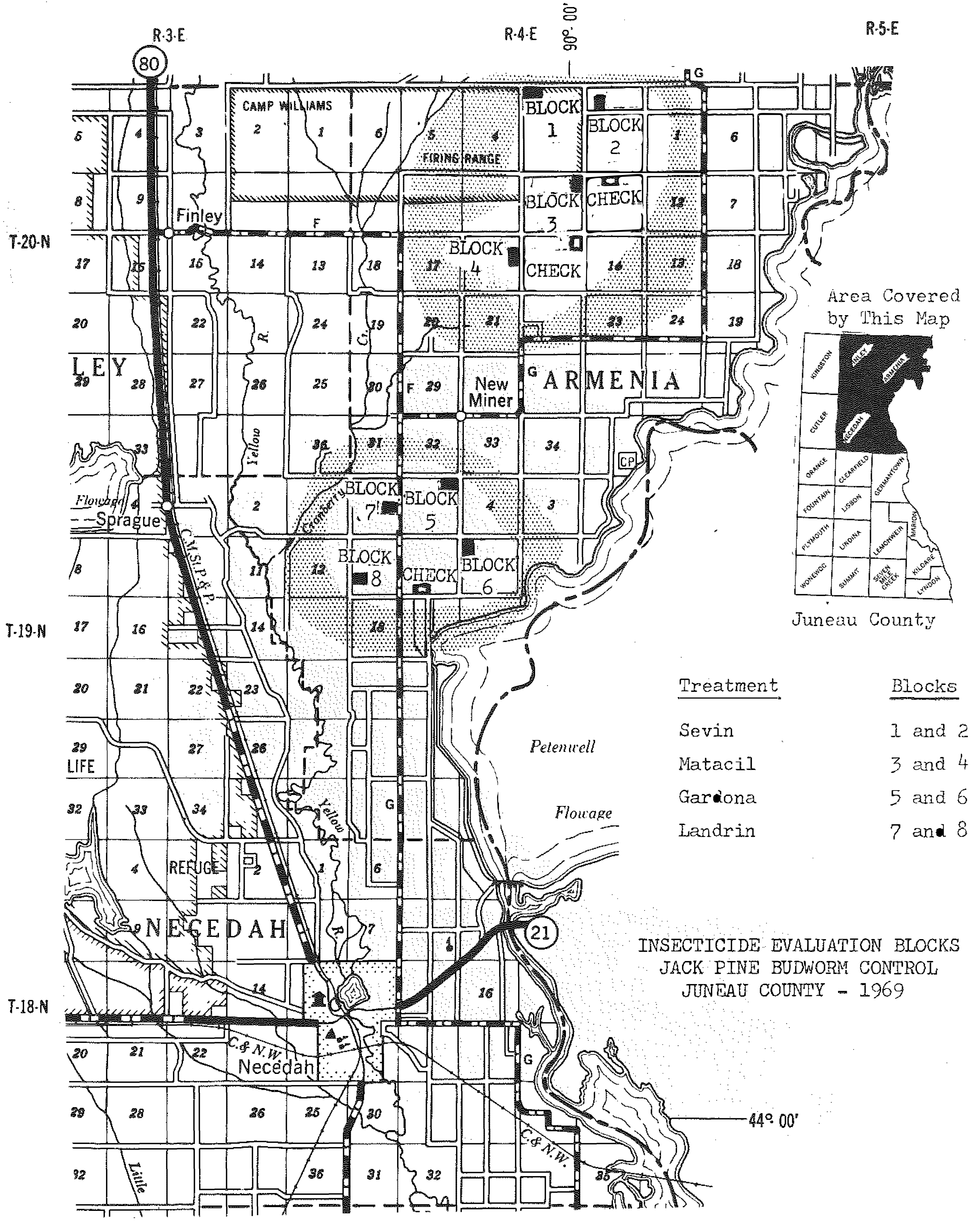
Abbott's formula was used in computing population reductions (Abbott, W. A., Journal of Economic Entomology, Vol. 18, No. 65, 1925).

$$Po = 1 - \frac{Cb \times Ta}{Ca \times Tb} \times 100$$

where - Po = population reduction %
Cb = pre-spray count check area
Ta = post-spray count treated area
Ca = post-spray count, check area
Tb = pre-spray count, treated area

Results

Percent population reduction indicated after each chemical in the following tabulation has been corrected for natural control. Rates of application indicate active ingredient per unit volume per acre.


R-3-E
R-4-E
90° 00'
R-5-E
80
T-20-N
T-19-N
T-18-N
44° 00'
CAMP WILLIAMS
FIRING RANGE
BLOCK 1
BLOCK 2
BLOCK 3
CHECK
BLOCK 4
CHECK
Finley
LEY
ARMENIA
New Miner
Yellow R.
Cranberry Cr.
BLOCK 7
BLOCK 5
BLOCK 8
CHECK
BLOCK 6
CP
Flowage
Sprague
C.M.St.P.&P.
LIFE
REFUGE
NECEDAH
Necedah
C.&N.W.
Little
Petenwell
Flowage
21
Area Covered by This Map
KINGSTON
FINLEY
ARMENIA
CUTLER
NECEDAH
ORANGE
CLEARFIELD
GERMANTOWN
FOUNTAIN
LISBON
PLYMOUTH
LINDINA
LEMONWEIR
MARION
WONEWOC
SUMMIT
SEVEN MILE CREEK
KILDARE
LYNDON
Juneau County

Treatment	Blocks
Sevin	1 and 2
Matacil	3 and 4
Gardona	5 and 6
Landrin	7 and 8

INSECTICIDE EVALUATION BLOCKS
JACK PINE BUDWORM CONTROL
JUNEAU COUNTY - 1969

County	Test Site Legal Description	Block No.	Insecticide	Rate of Application	% Population Reduction
Juneau	N½ Lot 4 Sec. 3 W½ Lot 6 Sec. 2 T20N, R4E	1 2	Sevin Sevin	Unknown (See text)	30.45%
	N½ NE¼ NW¼ Sec. 11 T20N, R4E		(Check area - no treatment)		0.00%
Juneau	E½ NE¼ NE¼ Sec. 10 E½ SE¼ NE¼ Sec. 16 T20N, R4E	3 4	Matacil Matacil	0.159 lb./13.6 fl. oz./A	49.72%
	NE¼ NE¼ Sec. 15 T20N, R4E		(Check area - no treatment)		3.63% increase
Juneau	N½ NE¼ Sec. 5 W½ NW¼ Sec. 9 T19N, R4E	5 6	Gardona* Gardona*	0.5#/gal./acre	0.6%
	S½ SW¼ Sec. 8 T19N, R4E		(Check area - no treatment)		16.3%
Juneau	NE¼ NE¼ Sec. 6 NW¼ NW¼ Sec. 7 T19N, R4E	7 8	Landrin* Landrin*	0.5#/gal./acre	73.0%
	SE¼ SW¼ Sec. 8 T19N, R4E		(Check area - no treatment)		16.3%
Marinette (No map)	W½ NE¼ Sec. 32 T37N, R18E		Landrin*	0.5#/gal./acre	72.3%
	SW¼ SE¼ Sec. 32 T37N, R18E		(Check area - no treatment)		9.9%

Difficulties with a 4 lb.-per-gallon suspension of Sevin in oil in the aircraft spraying system precluded an accurate evaluation of delivery rate.

The delivery rate is estimated to have varied between 8 and 16 ounces of active material in 16 to 32 fluid ounces of undiluted spray per acre. Control attributable to Sevin was 30.5%. Pre-and post-spray counts on untreated check blocks totalled 493 larvae for each count indicating negligible natural control had occurred between sampling periods.

Operational Data

Additional detailed information pertaining to specific tests may be found in the Operational Data reports which follow.

---

*A more detailed report on these tests will appear in University of Wisconsin - Forestry Research Notes, No. 148, to be published in June, 1970.

JUNEAU COUNTY - OPERATIONAL DATA - Landrin

TARGET INSECT: Jack-Pine Budworm - *Choristoneura pinus* (Freeman) INSTAR(S):3d-pupae
CHEMICAL NAME: 3,4,5 Trimethylphenyl methyl carbamate 40% and 2,3,5 Tmc-10%
PRODUCER: Shell Chemical Company
FORMULA NO.: Code No. 6-5-60-1
SIZE OF CONTAINERS: One-pound plastic bags containing 50% active ingredient, W.P.
PROPOSED RATE OF APPLICATION: 0.5 lb. active, in one gallon of fuel oil, per acre
ACTUAL RATE OF APPLICATION: 1.14 g.p.a. x 0.5#/gal. = .57#/acre
CALIBRATION MATERIAL: # 2 fuel oil
SIZE OF SPRAY BLOCKS TO BE TREATED: 20 acres NUMBER OF BLOCKS: 2
ACREAGE ACTUALLY TREATED: 42 acres AIRPORT: Necedah, Wisconsin
AMOUNT OF CHEMICAL LOADED: 49.5 gal.
AMOUNT OF CHEMICAL APPLIED: 48 gal.
AMOUNT OF CHEMICAL LEFT IN SYSTEM AFTER SPRAYING: 1.5 gal.
DISPOSAL OF EXCESS: Buried 20" below surface in deep sand at airstrip border.
AIRPLANE: Piper Pawnee - 150 h.p.
SPRAY TANK: 100 gal. fiber glass USEFUL TANK CAPACITY: 80 gal.
PUMP: Wind-driven Simplex, Size 1, Type cc.
TYPE CHECK VALVE: Spraying Systems #4666
STRAINERS: Removed from nozzles. #50 mesh in trap at pump.
SPRAY TIP DESIGNATION: Spraying Systems #8010 NUMBER TIPS USED: 16
POSITIONS OF NOZZLES USED INDICATED BY UNDERLINED NUMBERS BELOW:

LEFT WING:		RIGHT WING:
~~11-10-9-8-7-6-5-4-3-2-1~~	FUSELAGE	~~1-2-3-4-5-6-7-8-9-10-11~~

FLOW RATE: Proposed-12 gpm; Theoretical-16 gpm: Actual - 13.7 gpm.
EFFECTIVE SWATH WIDTH: 66 feet
PRESSURE IN SYSTEM DURING SPRAYING: 40 pounds
AIRSPEED: 90 mph
LEGAL DESCRIPTION OF TREATED BLOCKS: #7,NE¼NE¼ Sec. 6, T19N,R4E,#8-NW¼NW¼,Sec. 7,T19N, R4E
DATE OF APPLICATION: June 20, 1969
TIME OF SPRAY APPLICATION: START: 6:50 p.m. FINISH: 7:26 p.m.
NUMBER OF SWATHS FLOWN: #7-12; #8-9 LENGTH: 20 chains TOTAL CHAINS FLOWN: 420
DIRECTION OF FLIGHT: E and W, alternating; plane guided by balloons along each swath.
HEIGHT ABOVE CANOPY: 25' to 50'
AIR MOVEMENT AT TIME OF SPRAYING: #7 N-NW, 6 mph, gusts to 8-10; #8 - calm
TEMPERATURE AT SHOULDER LEVEL: 60.5° F.
PRECIPITATION: Thunder showers in a.m.
OTHER NOTES: Pre-spray counts made June 19; Post-spray counts, June 24
Check block located in SE¼SW¼ Sec. 8, T19N, R4E

Since the viscosity of the spray mixture appeared to be appreciably greater than that of # 2 fuel oil, sixteen spray tips were estimated to provide flow rate desired. The mixture flowed readily through the spray system and left it clean enough so little purging was required. One pound of 50% WP occupied 8 fl. oz. of space in 1 gal. of finished spray mixture.

JUNEAU COUNTY - Landrin

Visible spray deposits on foliage indicated a relatively narrow range of droplet sizes and uniform coverage of exposed surfaces.

Block #7 - Post-spray examination on June 21 at north end of block revealed abundant webbing and many larvae spinning down from tree crowns. Unidentified carabid beetles were dying or affected by the spray. Many dead Sarcophagid flies were observed on the ground in the openings in ground cover. Various species of ants appeared to be unaffected. Few active mosquitoes were noted.

Block #8 - About 16 hours following treatment, webs from trees to ground were abundant. Larvae suspended on silk were numerous. Visible spray pattern on oak leaves indicated coverage was good in the open. Coverage was good on the last swath at the south edge of the block which had not been sprayed over directly because the spray load was depleted about one swath early.

Two budworm pupae were noted in pre-spray checks of block #7 on June 19. One budworm pupa and many lady bug eggs were observed in block #8 on the same day.

During post-spray check of block #7 on June 24, the following were noted: 1 budworm pupa, many sluggish budworm larvae, 3 apanteles cocoons, a few mosquitoes, no deer flies, but many black flies.

Many dead aphids, 2 apanteles cocoons, and a few budworm pupae were noted in block #8 during post-spray survey, the same day.

MARINETTE COUNTY - OPERATIONAL DATA - Landrin

TARGET INSECT: Jack-Pine Budworm - *Choristoneura pinus* (Freeman) INSTAR(S): 4th-5th
CHEMICAL NAME: 3,4,5 Trimethylphenyl methyl carbamate 40% and 2,3,5 Tmc 10%
PRODUCER: Shell Chemical Company
FORMULA NO.: Code No. XP-893 May 6, 1968, Batch No. 738-100-1
SIZE OF CONTAINERS: 5 pounds per plastic bag, 50% WP
PROPOSED RATE OF APPLICATION: 0.5 lb. active, in one gallon of fuel oil, per acre
ACTUAL RATE OF APPLICATION: 0.57 lb./acre
CALIBRATION MATERIAL: #2 Fuel oil
SIZE OF SPRAY BLOCK(S) TO BE TREATED: 40 acres NUMBER OF BLOCKS: 2
ACREAGE ACTUALLY TREATED: 64 AIRPORT: Dunbar, Wisconsin
AMOUNT OF CHEMICAL LOADED: 81.5 gal. (41.5 gal. load #1, 40 gal. load #2)
AMOUNT OF CHEMICAL APPLIED: 80 gal.
AMOUNT OF CHEMICAL LEFT IN SYSTEM AFTER SPRAYING: 1.5 gal.
DISPOSAL OF EXCESS: Buried in deep sand near the airstrip
AIRPLANE: Piper Pawnee - 150 h.p.
SPRAY TANK: 100 gal. fiber-glass USEFUL TANK CAPACITY: 80 gal.
PUMP: Wind-driven Simplex, Size 1, Type cc.
TYPE CHECK VALVE: Spraying Systems #4666
STRAINERS: Removed from nozzles and trap at pump, none in system.
SPRAY TIP DESIGNATION: Spraying Systems #8010 NUMBER TIPS USED: 16
POSITIONS OF NOZZLES USED INDICATED BY UNDERLINED NUMBERS BELOW:

LEFT WING:		RIGHT WING:
11-10-9-8-7-6-5-4-3-2-1	FUSELAGE	1-2-3-4-5-6-7-8-9-10-11

FLOW RATE: Theoretical - 16 gpm; actual - 13.68 gpm
EFFECTIVE SWATH WIDTH: 66 feet
PRESSURE IN SYSTEM DURING SPRAYING: 40 lbs.
AIRSPEED: 90 mph
LEGAL DESCRIPTION OF TREATED BLOCKS: W½ NE¼ Sec. 32, T37N, R18E
DATE OF APPLICATION: July 9, 1969
TIME OF SPRAY APPLICATION: START: 6:30 a.m. FINISH: 7:20 a.m.
NUMBER OF SWATHS FLOWN: 16 LENGTH: 40 chains TOTAL CHAINS FLOWN: 640
DIRECTION OF FLIGHT: N and S, alternating; plane guided by balloons along each swath
HEIGHT ABOVE CANOPY: 25 ft. to 50 ft.
AIR MOVEMENT AT TIME OF SPRAYING: Load #1 - WSW, 0-1 mph; Load #2 - SSW, 3-5 mph
TEMPERATURE AT SHOULDER LEVEL: 59° F.
PRECIPITATION: Last rain 12 hours prior to spraying, slight mist during load #2, cleared as day progressed and no rain for at least 12 hours after.
OTHER NOTES:

Load #1 started on West side of block. Eight swaths completed. No. 7 nozzle on right wing drooling, diaphragm replaced after load #1. Load #2 started application on east edge of block and worked toward center. Spray deposits on foliage indicated that coverage was inadequate for 3 chain distance across middle portion at south end of block, and 4 chain distance at north end of block. In traversing the spray block approximately midway between the north and south ends, progressing from west to east a few hours after treatment the following were observed; the first visible spray deposit was noted ½ chain east of the north-south trail along the west boundary. Each swath was paced-off starting from the center of the first one along the west edge. Spray deposits on foliage, larvae spinning down, and insects on the ground indicated that coverage with insecticide had been good through the 10th swath from the west edge. No webs were encountered along the 11th flight line but started picking them up again along the 12th swath. Coverage dropped off again 21 to 23 chains from the east edge, but there was a trace of coverage on the 25th chain east of the spray block.

A railroad track angling northeastward across the area north of the spray block and one to three and one-half chains north of the spray block at the west and east edges respectively, was checked for spray deposit. Three-fourths of a chain east of the north-south road at the east side of the spray block the first visible evidence of spray deposit showed on foliage, the railroad ties and the rails. Spray deposition on rails and ties was uniform and apparently adequate along swaths one to nine progressing eastward. Swaths 10 to 13 had no spray deposit on the tracks. A few coarse droplets were evident along the path of the 14th swath. Coverage appeared to be good along the 19th swath. Spray deposit was still evident 5 chains east of the spray block.

Spraying of load # 2 started about 7:10 a.m. and a freight train passing the end of the spray block took about 5 minutes to cross the area. The spray deposit was good on the rails indicating the spray was falling for sometime after the train had passed. Spray was noted on the rails and ties for 4 chains north of the spray block and 7 chains east of the east edge of the block.

Birds were singing all over the sprayed area when it was examined later the morning of treatment.

Pre-spray counts were made on July 8. Larvae mostly 5th to 6th instars, 2 pupae noted, and Apanteles cocoons abundant check block SW¼SE¼, Sec. 32, T37N R18E.

Post-spray counts on treated block on July 12 showed some larvae still ballooning. Pupation was well underway. Webbing was very heavy where spray coverage was good and droplets were visible on open ground, jack-pine reproduction and ferns.

JUNEAU COUNTY - OPERATIONAL DATA - Matacil

TARGET INSECT: Jack-Pine Budworm - *Choristoneura pinus* (Freeman) INSTAR(S): 4th-5th
CHEMICAL NAME: 4-Dimethylamino-m-tolyl methylcarbamate
PRODUCER: Chemagro Corporation
FORMULA NO.: Batch No. 9050382
SIZE OF CONTAINERS: 5 gallon 3# active/gal.
PROPOSED RATE OF APPLICATION: 0.15#/in. 12.8 fl. oz. per acre
ACTUAL RATE OF APPLICATION: 0.159# active in 13.6 fl. oz. per acre
CALIBRATION MATERIAL: Panasol
SIZE OF SPRAY BLOCK(S) TO BE TREATED: 20 acres NUMBER OF BLOCKS: 2
ACREAGE ACTUALLY TREATED: 42.5 acres AIRPORT: Necedah, Wisconsin
AMOUNT OF CHEMICAL LOADED: 6 gallons
AMOUNT OF CHEMICAL APPLIED: 4.5 gallons
AMOUNT OF CHEMICAL LEFT IN SYSTEM AFTER SPRAYING: 1.5 gal.
DISPOSAL OF EXCESS: Buried 24 inches below the surface in deep sand
AIRPLANE: Piper Pawnee - 150
SPRAY TANK: Stainless steel USEFUL TANK CAPACITY: 20 gal.
PUMP: Wind-driven Simplex, Size 1, Type cc.
TYPE CHECK VALVE: Spraying Systems #4666
STRAINERS: 100 mesh at spray tips, 50 mesh in trap at pump
SPRAY TIP DESIGNATION: Spraying Systems #8001 NUMBER TIPS USED: 10
POSITIONS OF NOZZLES USED INDICATED BY UNDERLINED NUMBERS BELOW:

LEFT WING:		RIGHT WING:
11-10-9-8-7-6-5-4-3-2-1	FUSELAGE	1-2-3-4-5-6-7-8-9-10-11

Nozzles angled at 45° into airstream in level flight altitude
FLOW RATE: Proposed 1.2 gpm; Theoretical 1.0 gpm; Actual 1.27 gpm
EFFECTIVE SWATH WIDTH: 66 feet
PRESSURE IN SYSTEM DURING SPRAYING: 40 lbs.
AIRSPEED: 90 mph
LEGAL DESCRIPTION OF TREATED BLOCKS: #3-E½NE¼NE¼ Sec. 10, T20N, R4E; #4-E½ SE¼NE¼ Sec. 16, T20N, R4E
DATE OF APPLICATION: June 19, 1969
TIME OF SPRAY APPLICATION: START: 6:53 a.m. FINISH: 7:09 a.m.
NUMBER OF SWATHS FLOWN: 21.25 LENGTH: 20 chains TOTAL CHAINS FLOWN: 425
DIRECTION OF FLIGHT: N and S, alternating; plane guided by balloons along each swath
HEIGHT ABOVE CANOPY: 25' to 50'
AIR MOVEMENT AT TIME OF SPRAYING: Block #3 - slight drift from SW; #4 - same from NW
TEMPERATURE AT SHOULDER LEVEL: 68° F.
PRECIPITATION: Rain traps in block indicated no precipitation rest of day after spraying.
OTHER NOTES: Check block in NE¼NE¼ Sec. 15, T20N, R4E. Larvae more mature than in treated blocks.

No apparent problems developed during delivery of spray. Spray pattern on a car windshield indicated about 10 drops per square inch. Larvae started spinning down from trees almost immediately.

About 50 hours after treatment, on June 21, webbing was abundant in Block #3. Aphids were found alive in the same jack-pine shoots where dead larvae were found. Dead budworm larvae were found in open spots on the ground under the jack-pines. Larvae ranged from 3rd to 6th instars.

JUNEAU COUNTY - Matacil

In Block #4, same day, webbing was abundant. Lady beetle eggs numerous. Ground sparrow nest with 3 eggs, mother bird O.K. Pine spittlebugs unaffected in spittle masses. Deer flies and black flies apparently unaffected. Ants with red head and thorax, and black abdomen mostly dead on an exposed ant hill, but a few ants seemed unaffected.

Pre-Spray Checks June 17:

Block #3 - A few dead budworm larvae observed, about 1% of those counted. Dead larvae were found on larger trees and had large heads with stunted bodies. Defoliation was moderate in the block.

Block #4 - Many empty budworm webs noted, a few malformed larvae found on larger trees which had short new growth. Defoliation moderate to heavy.

Check Block, Sampled June 18. - Budworm larvae in small reproduction were healthy looking. Larvae were generally more advanced in development than in Block #4. Defoliation was light on reproduction and moderate on larger trees.

Post-Spray Checks June 23:

Block #3 - Aphids and pine spittlebugs in spittle masses appeared unaffected by treatment. Mosquitoes were numerous. Eleven Apanteles cocoons were counted in the budworm samples.

Block #3 - Eighteen Apanteles cocoons counted, budworm pupae observed, 1 pine tussock moth pupa; pine tortoise scale eggs hatching, crawlers on new shoots; no black or deer flies; a ground sparrow nest with 4 eggs, mother bird O.K. Thirteen Apanteles cocoons and 2 budworm pupae noted in samples.

JUNEAU COUNTY - OPERATIONAL DATA - Gardona

TARGET INSECT: Jack-Pine Budworm INSTAR(S): 4th-5th
CHEMICAL NAME: 2-Chloro-1-(2,4,5-Trichlorophenyl) vinyl dimethy phosphate
PRODUCER: Shell Chemical Company
FORMULA NO.: Unknown. 4 lb. active per gal. Oil soluble.
SIZE OF CONTAINERS: 5 gallon
PROPOSED RATE OF APPLICATION: 0.5#/gal./acre
ACTUAL RATE OF APPLICATION: 0.5#/gal./acre
CALIBRATION MATERIAL: #2 fuel oil
SIZE OF SPRAY BLOCK(S) TO BE TREATED: 30 acres NUMBER OF BLOCKS: 2
ACREAGE ACTUALLY TREATED: 60 acres AIRPORT: Necedah, Wisconsin
AMOUNT OF CHEMICAL LOADED: 61.5 gal.
AMOUNT OF CHEMICAL APPLIED: 60 gal.
AMOUNT OF CHEMICAL LEFT IN SYSTEM AFTER SPRAYING: 1.5 gal.
DISPOSAL OF EXCESS: Buried in deep sand.
AIRPLANE: Piper Pawnee - 150
SPRAY TANK: 100 gal. fiber glass USEFUL TANK CAPACITY: 80 gal.
PUMP: Wind-driven Simplex, Size 1, Type cc.
TYPE CHECK VALVE: Spraying Systems #4666
STRAINERS: #50 mesh stainless steel
SPRAY TIP DESIGNATION: Spraying Systems #8010 NUMBER TIPS USED: 12
POSITIONS OF NOZZLES USED INDICATED BY UNDERLINED NUMBERS BELOW:

LEFT WING:		RIGHT WING:
11-10-9-8-7-6-5-4-3-2-1	FUSELAGE	1-2-3-4-5-6-7-8-9-10-11

FLOW RATE: Theoretical - 12 gpm; Actual - 12 gpm
EFFECTIVE SWATH WIDTH: 66 feet
PRESSURE IN SYSTEM DURING SPRAYING: 40 lbs.
AIRSPEED: 90 mph
LEGAL DESCRIPTION OF TREATED BLOCKS: #5-N½NE¼ Sec. 5, T19N, R4E; #6-W½NW¼Sec. 9, T19N, R4E
DATE OF APPLICATION: June 20, 1969
TIME OF SPRAY APPLICATION: START: 5:28 a.m. FINISH: 6:50 a.m.
DIRECTION OF FLIGHT: N and S, alternating on Block #6, E and W on Block #5
HEIGHT ABOVE CANOPY: 25' to 50'
AIR MOVEMENT AT TIME OF SPRAYING: Block #5 - 3-6 mph from NW; #6 - 6-10 mph from NW
TEMPERATURE AT SHOULDER LEVEL: 48° F.
PRECIPITATION: None
OTHER NOTES: Check Block - S½SW¼ Sec. 8, T19N, R4E

Block #5 probably had no coverage on path of first swath along north edge of block, and poor coverage along the second swath because of air movement from NNW. Supplementary check plots put in through covered area.

Block #6 - Wind from 3-6 mph on ground and estimated 10 mph gusts from NNW above canopy during spraying.

Some Apanteles cocoons noted during post-spray checks on June 23.

JUNEAU COUNTY - Gardona

Because of poor results with Gardona in Juneau County, a second test in Marinette County was cancelled and the chemical was dropped from consideration as a candidate insecticide for control of the jack-pine budworm.

Sevin

An attempt was made to test a formulation containing 4 pounds of active Sevin in oil at a rate of one pound in one quart per acre of the undiluted formulation. The formulation packaged in 5 gallon cans, had 2" to 3" of sediment in the bottom of the cans. The supernatant liquid flowed freely through 100-mesh strainers under gravity. Twenty #80015 spray tips were fitted on the spray boom in anticipation of getting a 3 gpm flow rate. Nozzles plugged rapidly under pressure after a few minutes, and estimated delivery of 2 quarts of material.

All screens, except a 50-mesh screen at the pump trap, were removed from the spraying system. The #80015 spray tips were removed and replaced with eight #8004 tips, and 3 gallons of spray material were added to bring the total to an estimated 15 gallons. Seventeen swaths were completed over the second spray block which should have required only 10.

No conclusions were drawn pertaining to degree of control attained with this material. The formulation was not suitable for application with the available equipment, and about 4 man-hours were required to clean screens and nozzles. Even with all the problems of application some population reduction was achieved. See tabulation on page 53.

DI-SYSTON APPLICATION FOR BALSAM GALL MIDGE CONTROL

Fifty pounds of granules containing 15% Di-Syston were applied on 0.8 acres of a balsam fir Christmas tree planting. The trees numbered between 1,000 and 1,200 per acre and were about 6 feet tall. The rate of application approximated 9.4 lbs. of active material per acre. About 2 acres were left untreated. The treatment was made in NE¼SW¼ Sec. 36, T31N, R1E on May 17, 1969.

Five galled needles from each of 4 trees in the treated block and from an equal number of trees in the untreated acreage were examined on August 26. The following observations were made:

Treated Trees			Untreated Trees		
Tree No.	Living Larvae	Dead Larvae	Tree No.	Living Larvae	Dead Larvae
1	0	5	1	5	0
2	2	3	2	5	0
3	0	5	3	5	0
4	5*	0	4	5	0

*Tree may have been missed by treatment.

Needles with galls containing dead larvae were as well developed as those with living larvae. Needle drop was expected to occur about the same time on both treated and untreated trees.

About one-half of the dead larvae were as large as the living ones. The remainder were smaller and partially disintegrated.

A similar application earlier in the spring may prevent or reduce gall formation.